

ORGANISMS FOUND IN THE PHIPPS CONSERVATORY TANKS.—1. CATENULA?  
2. GROMIA OVIFORMIS.

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### Microscopical Life in the Phipps Conservatory Tanks, Allegheny.

By JAMES H. LOGAN,

ALLEGHENY, PA.

WITH FRONTISPIECE.

[Read by Dr. W. H. Holland for the author before the Iron City Microscopical Society, Dec. 13, 1894.]

The donor of Allegheny's greenhouse little thought when establishing it how fine a treat was being provided for those who delight in searching out the wonders of microscopical life. In the large collection of plants, both learned and unlearned may find much to admire and instruct.

We are, however, now concerned with the tanks, wherein exist an invisible flora and fauna equal in interest and wonder to the larger ones which appeal to the naked eye. Here, absence of violent agitation in the water, together with abundant food and warmth, supply the necessary conditions for the growth and development of numerous animalcules and microscopic plants.

There are three sources to which the presence of all these forms may be referred.

First, we have the river water which traversing the mains and pipes carries along some of these organisms or their eggs. Few and scattered though these be, they increase prodigiously when placed amid favorable surroundings. As most of these multiply by binary subdivision, it is easy to see how in the course of not many

days a single individual may grow into millions and billions. Such water generally has a peculiar odor which makes one hesitate to drink it. Obviously, it would be a great mistake to take this water as a sample of that which we drink.

In the second place, earth and plants put into the tanks contain many eggs of various kinds which likewise soon develop and increase largely.

Thirdly, there is the external air always full of dust and germs. Currents of air entering the Conservatory through the smallest crevices or openings bring in many germs, which fall into the tanks and there develop. Tyn-dall's illustration of floating matter in the air is familiar to many. Indeed, in view of this, the wonder seems to be that animalcules are not far more numerous than we find them. It must be borne in mind, though, that all of them have many enemies to check their too rapid increase or are often placed where conditions do not favor them.

It now remains to treat in detail some few of the many interesting objects to be found in these tanks.

On the under side of the leaves, or on the stems of pond lilies, snail eggs are common. These are very transparent and provide one of the best means for watching the development of the snail. In fresh-laid eggs we see a little dark colored spot on the central part of each egg. Next we observe a division or segmentation of this small mass, and thereafter it gradually increases in bulk and different organs come into view. Finally, we have a fully formed snail, shell and all, almost completely filling the egg. Then the animal by tugging and pushing makes a rent in the thin egg case, and, emerging, immediately crawls about in search of food. Snails it may be added, destroy large numbers of microscopical forms. One may observe the track of a snail on the under side of leaves or on the sides of glass jars. It is very much like that left by the scythe of a mower. The

eggs may be found in the tanks at all seasons, even in the winter.

Of Nais worms there appear to be quite a number of species. They may be seen projecting from their tubes in the mud and swaying from side to side with a graceful undulating motion. They are easily alarmed and instantly vanish within their tubes when one attempts to catch them. They vary in length from  $\frac{1}{4}$  inch to 2 inches. Some are blood-red, others light brown or colorless. Certain kinds creep along the stems of water plants, or in the slime swallowing great mouthfuls of confervaceæ, and the animalcules entangled therein. One species has a probosis very much like an elephant's. Another is transparent, but covered with round red spots, presenting an appearance strikingly like that of calico so ornamented.

Planarian worms are apt to be found in every gathering. Many species are round, some broad and flat, others longer. The black spots commonly observed in the head and referred to as eye-spots, seem to the writer to be nervous ganglia. These worms have cilia, like infusorians, but their very rapid motion causes them to be invisible.

A very peculiar worm of this family was found last August, and appears to be a *Catenula*. A drawing of the same is submitted. (Fig. 1.) The first individual seen had seven segments, each a complete worm just ready to separate. It moved through the water with an easy gliding motion bending from side to side in its course. On the hinder segment fine straight cilia were very plain; but only indications of them were present elsewhere. Being kept for observation, this individual the next day had separated into two parts, one of three and the other of four segments. Although watched for nearly a week that of four segments swam around freely, but did not again divide. It was then lost.

Once, an infusorian, an *Urostyla*, in darting hither and

thither as is its usual habit came near a worm of one segment. With a suddenness that was unexpected, the worm bent its head, darted forward, two large flaps at the mouth opened out and the Urostyla was gulped down. The curious part of it, however, was that within a few seconds after entering the stomach of the worm the Urostyla dissolved away. Without witnessing the actual capture of its prey, it could not be told upon what this worm fed, as the contents of the stomach were an undistinguishable mass. Generally animalcules which are captured by others remain for a considerable time before being dissolved by the digestive fluids.

What the round object in the head represents, I have not been able to ascertain. It has a bright center and dark border as the drawing represents it.

Great voracity is characteristic of these worms. Some have been observed swallowing numerous sand grains with the vegetable matter constituting their ordinary food.

The crustacea are well represented in these tanks at nearly all times by such genera as *Daphnia*, *Cyclops*, *Cyhris* and others. All of these are ravenous feeders much to the discomfiture of the microscopist whose choisest specimens they cause to disappear.

Zoophytes have an example in the beautiful *Plumatella repens*, often covering the sides of tanks or the under side of leaves with a network of branching tubes to the extent of several inches. They are easily discerned by the unaided eye, but it is difficult to detach the tubes without injuring the animals within.

*Hydra fusca* and *Hydra viridis* representing the Cœlenterata appear in the same situations and also attached to various water plants. While plentiful at times, there are occasions when none at all can be found. A practised eye easily finds them without a magnifier. They feed upon water-fleas, Nais worms, and indeed, any kind



of animalcule heedless enough to come in contact with their tentacles. Hydra is sometimes observed, stubbornly holding on to a Nais worm larger than itself, and the spectacle is entertaining as well as exciting. Usually the Hydra conquers.

Of genera included under the Rhizopoda, quite a number are found. Arcella and Difflugia are not infrequent, but seldom appear in large numbers. Difflugia urceolata and spiralis (Leidy), have been found, and several of the last species appeared in pairs joined mouth to mouth just as he describes and figures them. Cyphoderia, Nebela and Euglypha have also been detected.

Gromia oviformis, of which a drawing from a sketch made at the time is shown in Fig. 2, was found over a year ago in the mud from a tank. This is most unique and instructive as being the only fresh-water representative of the Foraminifera, which occur in such immense numbers in the Ocean and form vast deposits at the bottom thereof. Gromia as found in the conservatory had a test or shell of a dirty white color, sometimes inclining to yellow. The pseudopoda were thrown out in numerous filaments far finer than spider lines; often anastomosing, and filled with minute bodies traversing back and forth. The filaments were often more thickly crowded than shown in the drawing. The mouth is not always well displayed, as it is the habit of the animal to collect a mass of mud or debris there. The writer detached this mud from several, but the next day found that every one of them had buried its mouth in mud again.

There is surely a reason why Foraminifera are not permitted to abound in fresh-water bodies. It is easy to discern that in the ocean they subserve a useful purpose depositing much of the soluble carbonate of lime it contains, and that the great beds of their dead shells now forming may in future ages be elevated to the sur-

face as marble, and utilized in the erection of stately buildings, just as similar beds formed long ago are used in our day. It would seem that their presence in lakes and ponds might ultimately fill them up ; but just how they would act in the flowing waters of rivers is not so easy to answer.

*Amœba princeps*, *verrucosa*, and *radiosa* have been found. The first named species was obtained in large numbers only once, on which occasion a paper was read before the Society stating some new facts then observed. Since then search has been made for *Amœba* in the hope of witnessing a recurrence of these things and further developments thereof, but without result thus far. Phenomena of this kind, it may be, occur only at particular seasons. There is no doubt, but that others who keep on the watch will sooner or later see the same things and be able to verify them. The probability is that a great deal more than is suspected still remains to be learned concerning *Amœba*.

Elegant and remarkable forms of the Rotiferæ are always present. *Philodina*, *Rotifer*, *Brachionus*, *Actinurus*, *Notholca* and *Pterodina* usually appear each season, but not in great numbers. *Melicerta ringens* appears now and then. The beautiful *Floscularia* may be found by careful search of the under side of pond-lily leaves. An individual captured this year, deposited a cluster of no less than a dozen eggs at the base of its tube. It was the intention to keep these and watch their development, but they were unfortunately lost.

*Apsilus lentiformis* is, perhaps, one of the most remarkable of the Rotiferæ. It was captured in October this year, only six or eight being found on the under side of a lily leaf. It had previously been found only a few years ago on the leaf of a similar plant in a little pond at Mr. Elliott's greenhouse. This Rotiferon appears to be never abundant and the microscopist who is success-

full in bagging one or two may well feel as much exultation as the sportsman does over his capture of larger game.

Living diatoms occur to a greater or less extent in the mud or attached to water plants. *Surirella*, *Pinnularia*, *Nitzschia*, *Stauroneis* and the curious form *Amphiprora* are not infrequent.

*Closterium* and *Sarcina* are sometimes so abundant as to cover the bottom of the tanks with green patches. The latter appears of a dark bluish green color, while the former is a lighter and brighter green. By this difference in tints one is able to determine the presence of these genera ere subjecting the material to examination under the microscope.

*Euglena viridis* may often be known by the appearance of green cloudy masses, or streaming bands in the tanks. It does not here occur as a thick powdery green scum like that often seen in the open air in shallow stagnant pools.

Other infusoria thrive in great numbers both as to genera and species. The very curious genera *Rhipidodendron*, *Spongomonas* and *Anthophysa* were obtained in gatherings from the tanks. *Actinophrys*, *Leucophrys* and *Spirostomum* will be met with from time to time.

Bacteria, concerning which so much has been said in the papers and journals, are always to be found. They are most abundant around bits of decaying vegetable matter. In connection with them in such situations *Paramecium* is usually to be seen. When this infusorian is in a favorable position under the glass, a current of pale granular may be detected swiftly flowing into the funnel and collecting into a globular mass at its termination. This ball keeps increasing in diameter for some time, then it separates and slowly floats away among other food-balls within the body of the animalcule. At least two or three of these balls are formed every minute

and in this way *Paramecium* destroys prodigious numbers of Bacteria. For all this, however, the hosts of Bacteria do not appear to be very materially reduced. Many other infusorians feed upon Bacteria, and some of them are so small that they can only capture one Bacterium at a time.

Enough has now been said to convey some idea of the variety and abundance of microscopic life in these tanks. Although no opportunity has come for the writer to investigate the Schenley Park conservatory, their tanks will doubtless prove equally rich and interesting.

Any one of the species referred to in this paper will furnish work enough for a year, or even years, and abundant material for an interesting monograph. As every fresh gathering of the same species is apt to supply some new feature, one who has taken up these studies with any degree of success, is prone to be lured on further and further into this world of enchantment. Every humble worker, provided he makes truthful drawings and notes of what comes to his view under the glass, stands a chance to do something of value.

In hunting for animalcules one must be prepared to encounter a goodly share of disappointments. Sometimes this is due to his own want of skill or patience. Yet, animalcules come and go in the most unaccountable ways. One season a particularly interesting kind may be found in profusion, and then not appear again for years. This uncertainty only adds zest to the search for these most interesting objects of which there will always be some to repay all the time and trouble spent in obtaining them.

Some may regard all this time and labor as wasted, but to such it may be answered that if Nature has taken such pains to adorn with beauty and endow with marvellous contrivances and instincts these minute beings, it is surely proper for us to search out these won-

ders, take delight therein and be thankful for the privilege of beholding them.

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[In this connection attention is invited to a article on home aquariums in the December *Microscope*. Any one can cultivate these forms and without much expense. All needed directions are contained in that article by Tempere, of Paris. Or, the forms may be obtained from the author of the foregoing article.—EDITOR.]

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### The "Oyster Epidemic" of Typhoid at Wesleyan.

By PROF. H. W. CONN

MIDDLETOWN, CONN.

While it has for some time been suspected that raw oysters may be a possible means of the distribution of germ disease there have been no cases where the theory has been positively demonstrated. The recent outbreak of typhoid at Wesleyan University, is in this respect, therefore, so unique as to be of especial interest and for this reason the results of the investigation as to the cause of this outbreak are given below in some detail.

The history of the epidemic was as follows. About October 20th there began to appear among the students a number of cases of mild fever which were for several days not regarded as serious. After about a week, however, one or two of them developed into typical typhoid fever, and several others were suspected of being of the same nature. For a week and a half following October 20th new cases appeared somewhat rapidly, and by November 1st there had appeared among the members of the college about 23 cases of fever of more or less pronounced typhoid character. After November 1st the number of new cases diminished, although two appeared on November 2nd, one on November 4th, and one as late as November 8th. Subsequent to that period no new cases have developed. There have been among the students about 26 case of fever which have been with more or less reason regarded as typhoid. Of these 23 have been pronounced typhoid by the physicians in charge,

while the others are of such slight nature and have so few typhoid symptoms as to make it at least doubtful whether they were really typhoid fever. Of these cases of undoubted typhoid 13 have been very serious and the others not very serious. Three deaths have occurred and at the time of writing there are two or three other patients in a very critical condition. It will be noticed from these facts then that the outbreak of typhoid fever in college began about the 20th of October, and the last case occurred about November 8th.

As soon as the serious nature of the disease was recognized an investigation as to its cause was begun. Of course at that time it was not known that the disease would be limited to the dates above mentioned and it was regarded as possible that there was in college a constant source of infection. The students that were sick were found to room in all of the college buildings and also in several houses in town. Moreover, it was seen that they did not board at the same boarding place, and there appeared at first, therefore, to be no connection between them except the college campus. The first object of suspicion was the water from two wells at the back of the college buildings, which was used occasionally by the students of the college for drinking purposes. On this suspicion the use of the water was immediately stopped and an examination of the wells was made. Chemical examination showed in one of the wells an exceptionally large amount of albuminoid ammonia. The examination was made immediately after a heavy rain following a long drought which might possibly have accounted for this. A bacteriological examination was immediately set on foot according to the method of Prof. Vaughn. Bouillon cultures from the water of each well were made and cultivated for two days in a culture oven. Then twenty cubic centimeters of the culture were inoculated into the abdominal cavity of white rats. The

white rats, however were entirely unaffected by the treatment, indicating plainly that the pathogenic germs of a typhoid nature could not have been present. Moreover, a little inquiry soon showed that the wells could not have been the cause of the trouble. In the first place several of the students who were sick had certainly not drank from either of the wells. Secondly, the wells were used almost as much by certain young people from the town as by the students themselves and there was no corresponding outbreak of typhoid in the city. In fact Middletown at that time proved exceptionally free from all kinds of fevers. These facts taken together made it necessary to exclude the well from the possible sources of infection.

It was noticed at the outset that the ladies of the college, about fifty in number, were exempted from the disease. This, of course, indicated that the cause of the infection could not have been in any unsanitary condition connected with the public college buildings in general, but must have been some source of infection to which the young men were exposed and not the young ladies. After carefully looking over the facts it was further found that all of the cases of sickness with three exceptions occurred in three of the college fraternities. The men did not all room in the fraternity buildings, though most of them did board at the fraternity club houses. This localizing of the disease to three fraternities proved the first usable point of departure in the investigation.

In the college there are seven fraternities and most of the college students board at the fraternity clubs. In the three fraternities afflicted there were about 100 students, and of the 100 students as above stated about twenty-five cases of typhoid developed. This is seen at once to be an extremely large proportion. It is usually supposed that some 10-15 per cent of those exposed to typhoid take the disease and here was a percentage at

least twice that proportion. This large percentage indicated at once that there must have been some extremely virulent source of infection to which probably every member of the fraternities was subjected. In no other way could the large percentage of cases among the students be accounted for.

In the attempt to locate the source of the trouble in connection with the three fraternities, however, every source of possible contagion was investigated. The plumbing was examined, and though found to be defective in at least one case, in the other houses it was in first class condition. Of course it was hardly possible to accuse the plumbing, however, inasmuch as the three clubs afflicted were situated at a distance of half a mile from each other and were connected with different sewers. The probability that these three houses should have been defective in their plumbing at the same time was very remote and their connection with different sewers, together with the absence of typhoid from the city made it impossible to accuse the plumbing. The possibility of transference of the disease from house to house was also considered, an attempt being made to find some early case which could possibly have been a source of infection to the other houses. But this proved futile. There were no *early cases*, for almost at once, upon October 20th, two or three cases developed simultaneously and, of course, this made it impossible to explain the epidemic by personal contagion. It was found, moreover, that the students who were taken with the disease in many cases had no connection whatsoever with the other fraternity houses, either through their roommates or otherwise. Another source of possible infection was suggested in a lot of new foot ball suits which had recently been purchased, and which had been thought to have given rise to one or two cases of blood poisoning. Inquiry, however, soon showed that most of the students



who were sick had had nothing to do with the foot ball suits, and they were of necessity ruled out.

Naturally one of the first objects of suspicion, after the disease had been located among the members of the three fraternities, was the table of the clubs. An examination was immediately made into the sources of supply of these three fraternities. All of them used the city water, which, of course, made it impossible to accuse the water as a source of the typhoid, there being no corresponding fever in town. The milk supply of the three fraternities was also ruled out by several facts. The three fraternities were supplied by two different milk men, and each of these milk men supplied one or more of the other fraternities in college, as well as a large number of customers in town. Moreover, upon inquiry it was learned that these milk men had not exchanged milk with each other, and that they lived at a distance of several miles from each other outside of the city. No cases of typhoid fever could be located in or near either of the milk farms as having occurred within the last six months. It was, therefore, impossible to accuse the milk. In the same way all the other articles of food used by the fraternities were investigated without success. The three fraternities did not have the same grocer nor the same butcher nor the same butter supply, nor did they obtain fruits from the same sources; and wherever in regard to any article of food it was found that there was a point of likeness between the three fraternities, it was found at once that the other fraternities in college shared with them in having the same source of supply. After carefully inquiring into every article of diet used on the ordinary table, it was found necessary to exclude the table as a source of infection. The attempt was then made to find some special unusual article of food that had been used during the fall by the three fraternities but it was impossible to do so.

When the dates of the outbreak above given are considered it will be seen that they have themselves almost conclusively pointed to one single source of infection that had occurred in these three fraternities at a date something like two weeks earlier than October 20th. The period of incubation of typhoid fever is known to be from eight days to twenty-eight days, and all of the cases came in such close connection with each other as to indicate almost beyond question that they were due to one single source of infection that occurred within two weeks prior to October 20th. Upon the 12th of October all of the fraternities in college held their annual initiation, followed by an initiation supper, and suspicion was soon thrown upon these suppers. The date of the suppers was exactly such as would be needed to explain the outbreak and as soon as it appeared that new cases diminished after November 1st, these suppers became the most probable source of infection. When the initiation suppers were taken into consideration one of the three exceptions, above mentioned, disappeared, because one of the men who did not belong to the college fraternity, had attended one of the three initiation suppers. An examination of the bills of fare at the suppers in question was therefore instituted. It was found that nearly every article of food must be excluded on the same grounds as the articles of food at their ordinary table. Their milk, their water, their ice, their ice cream, their fruits, their celery, and in fact, nearly all other articles of diet, they either did not obtain from the same source, or obtained them from a source which supplied every other one of the seven college fraternities as well as the people in town. There was found, indeed, to be but three points of common union between the three fraternities. One was the celery used in the salad, a second, a small amount of fruit, and the third the oysters which were eaten. The celery and fruit, however, were from

sources which supplied other clubs and a large part of the town's people and could, therefore, not have been the cause of the special infection confined to these three fraternities.

As soon, however, as it was found that the three fraternities each ate raw oysters from the same oyster dealer, the problems began, one after the other, to be solved. It was found that none of the other four fraternities ate these raw oysters. Two of them ate no oysters, a third ate oysters which had been cooked, and the fourth obtained oysters from an entirely different source. Nor could it be learned that the lot of oysters had been used raw to any extent among the people in town, most people cooking their oysters. Another one of the above mentioned exceptions was also explained at once, because the student upon being questioned, stated that about the time of the initiation suppers he had eaten of the raw oysters in the store of the oyster dealer. The oysters in question were served at each fraternity on the half shell at the beginning of the supper, and it was, therefore, almost certain that every person who attended the banquet ate of them. Correspondence and questioning, however, were immediately instituted which resulted in tracing in this way a connection between every student who was suffering from typhoid and these oysters, with one doubtful exception of a student who has not yet been personally questioned. It was learned also that there were in attendance upon these three suppers, in addition to the students in the college, a considerable number of alumni from out of town, and five students from Yale college. Letters were immediately written, therefore, to all of these persons to learn if they had eaten of the raw oysters, and whether they had suffered from any febrile disturbances. It must be remembered that the alumni were, as a rule, considerably older than the students and it was, therefore, to be expected that the alumni would

be more likely to be exempt from the disease than the students themselves. From twenty responses received from the alumni it was found, however, that there were two cases of genuine typhoid fever, which had developed simultaneously with those in the college and that there were three other cases of sickness which had not been regarded as serious. These might or might not have had some connection with the banquet in question, though it is quite doubtful. Of the five students in Yale college, two were taken with typhoid symptoms at just four weeks after the banquet. One of them developed into a severe case of typhoid fever and the other one is convalescing. In regard to these two cases at Yale it should, however, be noted that they appeared quite late, indeed, four weeks after the supper had been held, and although four weeks is not too long a period of incubation to be possible, still it is unusual. They developed, however, at exactly the period that the last case in Wesleyan made its appearance. It is also a fact that there were two other cases of typhoid fever in Yale college that certainly had no connection with these banquets or these oysters, and it is therefore not certain that these two cases are to be attributed to these banquets. It is, however, a remarkable coincidence that of four cases of typhoid at Yale, two should have been those who attended the banquet at Middletown and ate of the oysters in question and that these two should have developed within the four weeks following the banquet. It is therefore at least probable that these cases were due to the same cause.

It will be seen that, as soon as the oysters were accused of the trouble two of the three cases above mentioned of cases occurring outside the fraternities were at once explained. The fourth case remained isolated. This case was a member of the faculty, who had not attended either of the banquets. He was taken with a

slight fever and inasmuch as it appeared at about the same time with the students, it was regarded as identical with the other cases. It proved, however, a very slight fever, lasting only a few days, and it is therefore at least doubtful whether it was typhoid. Whether this person ate of the raw oysters cannot be positively determined. It is a fact that raw oysters were eaten at the table where he boarded at about the time of the banquet, but yet no positive connection between the person and these oysters has been made out. Whether, therefore, this case is to be regarded as an isolated case of fever having no connection with the others and not strictly typhoid fever, or whether it is a fact that it is also explained by some connection with the infected oysters has not been determined.

Inquiry was made at once as to the source of the oysters and it was learned that while they had grown in the deep water of Long Island Sound, they had been deposited in the mouth of a fresh water creek for a day or more to freshen. This freshening, as is well known, consists of the absorption by the oysters of fresh water which causes them to swell up and become plump. These oysters had thus been "fattened" before being sent to Middletown. Further inquiry showed that within about 400 feet of the place where they had been deposited was the outlet of a private sewer coming from a house wherein were two cases of typhoid fever. The persons in question were a lady and her daughter. They were taken sick at such a period as to call in a physician for the first time October 11th which, of course, means that the disease had been in its period of incubation for probably considerably over a week earlier. The oysters were sent to Middletown upon the 10th of October, and therefore they were deposited at this place in exactly the time to receive contamination during the early days of these two cases of typhoid. Of those two cases one

proved extremely severe and the lady died on the 21st of October. In the other case, the fever, after running about five weeks, disappeared and convalescence set in. It is, of course, very easy to understand that the typhoid germs could have found entrance into the oysters from this source of contamination. Now it has been known for some time, having been shown by Foster, that the typhoid germs will live for a long time in sea water, or indeed, in a concentrated salt solution. The specimens of the oysters from the creek, however, were put into the hands of Dr. Foote of Yale college, who soon showed that if the typhoid germs were forced in between the two valves of the shell they would remain alive in the oyster for a time sufficient to enable the oyster to be carried to Middletown and to be used at the initiation banquets. Whether or not they will grow and multiply in oysters has not yet been positively determined.

Shortly after the oyster had been placed under suspicion it was learned that there were at Amherst college several cases of typhoid fever. Correspondence was at once instituted which resulted in showing that at Amherst there had been held an initiation supper on the night of October 12th. Most of the cases of typhoid at Amherst occurred among the members of one fraternity, who, as at Wesleyan, neither roomed nor boarded together. They, however, had attended the initiation supper on October 12th, had eaten of raw oysters at the supper; and inquiry showed that these raw oysters also came from the same place and had been fattened in the mouth of the same creek. As at Wesleyan certain wells were first placed under suspicion but examination showed them to be good. While, of course, this did not conclusively demonstrate that the cases at Amherst were due to the same source of infection as that at Wesleyan it rendered it at least probable.

The facts above related, it will be seen, point with

conclusive force to the oysters as the cause of the typhoid outbreak. The dates of the outbreak, October 20th to November 8th, plainly point to *one* source of infection about October 12th. The fact that these two cases of genuine typhoid developed at the same time among the alumni, and that two others appeared also among Yale students, none of whom have had any connection with the three fraternities later than the initiation supper or before that time, plainly demonstrates the initiation supper on October 12th as the time of the infection. At these initiation suppers only one article of food or drink was used by the other fraternities in college and by the people in town in general. That one article of food, the raw oysters (not eaten raw by people in town in general), was learned to come from a place where it was certainly subjected to a probable contamination of typhoid fever from two severe cases of the disease. The use of raw oysters from the same locality elsewhere, has been found at least in one case to have been followed by a similar outbreak as occurred at Wesleyan. These facts taken together leave no possible doubt that the Wesleyan typhoid fever was caused by the oysters in question.

It must not, however, be inferred that because the lot of oysters supplied at these initiation suppers was infected, therefore, that all the oysters from the same locality would be thus infected. The public press has certainly exaggerated the condition of affairs. The oysters from the same locality were widely used in Connecticut and doubtless in many cases have been eaten uncooked. There have been, it is true, quite a little typhoid fever in Connecticut during the past month, but it has not been possible thus far to trace very much of it to the eating of raw oysters. The probability is that the oysters fattening in the locality in question would not as a rule be contaminated, but that it would only be an exceptional condition that would produce the result. It would be necessary

that they should be lying in this place at just the period when the typhoid germs were swept by the currents or eddies from the sewer over the oyster bed, and such a condition, even though there might be continued cases of typhoid in the course of the sewer, would doubtless not by any means be a constant one. Oysters as a rule are said to open their shells on flood tide rather than ebb tide, and this would, of course, make it more difficult for them to be contaminated by sewage from sewers above them on the creek. While this would by no means make impossible the chances of contamination it would certainly render it less. It is not to be supposed, therefore, that the oysters deposited in the creek for fattening would all, or indeed many of them, become contaminated by the typhoid material, but that only exceptional conditions would produce the result. Where a private sewer containing typhoid excreta opens in the vicinity of such an oyster bed the danger must certainly be considerable. Where the typhoid material is mixed in the city sewers with the large amount of sewage, and is subsequently diffused through a considerable body of salt water when the sewer empties into the sea, the danger of oyster contamination must be considerably less. But there must be danger to public health from oysters fattened in any fresh water in the vicinity of sewage. Doubtless many cases of mysterious typhoid have been due to such a cause. To trace these cases is a matter of extreme difficulty. The peculiar conditions which have occurred here have been such, however, as to bring the matter into clear light, and to throw with certainty blame of typhoid distribution upon a source which has for some time been suspected but not demonstrated. That the practice of fattening oysters in the mouth of rivers and in the vicinity of sewers is dangerous to the public health is beyond question shown by the combination of conditions which have attended the typhoid at Wesleyan.



## Coriander "Seed."

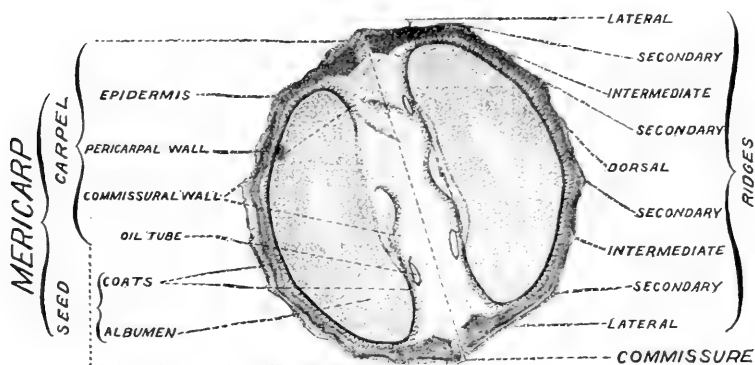
By R. H. WARD, M. D.,

TROY, N. Y.

(From Note book U2, of the American Postal Microscopical Club.)

This transverse section through the entire fruit of the coriander (*Coriandrum sativum* L.) is shown to illustrate the fruits of the Parsley family of plants (Umbelliferae). The whole fruit being of typical seed-like size and general external appearance, is called in the language of the kitchen and the shops, the "seed."

Under the microscope with a 2-inch objective, it is seen as shown in the figure to be composed of a pair of



dry, hard, somewhat hemispherical mericarps (half-fruits), each containing, and nearly filled by a single fleshy seed. These two mericarps were originally the couple of carpels, or seed-bearing leaves, which together constituted the compound pistil of the flower; and now, being fully matured, they maintain the same general arrangement, though the comparatively simple ovule has developed into the more elaborate seed. They remain more or less coherent into a "compound fruit," although in the other genera in this vast family they usually separate when ripe. Obviously the chief outer wall of this

so-called seed, marked "pericarpal" in the figure, is no part of any seed, but of the fruit-shell inclosing the seeds.

As the stamens, petals and sepals apparently grow from the top of the ovary (this portion of the pistil,) and are hence called "superior" while it by contrast is called "inferior," though their theoretical origin is from the stem below it, the walls of these carpels must include, consolidated with them, the bases of all those organs. It is well to search for, though often difficult to find in the sections under the microscope, indications of this complex origin.

Of the longitudinal ribs, five on the back of each mericarp, which usually show, in this family, as keel-like ridges on the outside of the fruit, and as projecting teeth around a transverse section like this, the median one, the mid-vein of the carpellary leaf, is called the dorsal, those near the edges of the carpel, the lateral and the intervening ones the intermediate ridges. Usually they are prominent, as in the caraway, and in the depressed intervals or furrows between them occur the large oil-bearing tubes (vittæ) which are so highly developed in this family of aromatic plants. But in the coriander these primary ridges are reduced to the wavy lines to be seen on the fruit, and lying low in the section as here observed, while the intervals have overgrown into high, though scarcely keel-like secondary ridges without oil-tubes; these tubes being produced, two in each, in the inner walls near the junction (commissure) of the two carpels, three of the four being preserved in this section.

Histological details are not shown with this power, but come into view under the 1-4th in. objective.

This great family of plants, justly famous for its aromatic products gives, among its more fragrant and useful contributions to food and refreshment, the anise

angelica, caraway, fennel, celery, parsley, and the more plebeian carrot and parsnip. It also supplies, of famous poisons, the hemlock, water hemlock and fool's parsley; and a scarcely more attractive lot of gum resins. The latter are, beyond competition, headed by the fetid asafœtida, which is said to be considered by the Persians a "delicious condiment," the leaves and roasted root being also eaten; but which, as rumor assures us, was not so esteemed by the invalids of nearer countries, when it was administered to them as a remedy by the physicians of olden times. As to the use of this plant for food, it will be noticed that the leaves and root may not always have the characteristic odor and acidity of the plant; or if they do it must be mitigated by the cooking, or they could hardly be eaten. Such characteristics vary greatly in different climates; and the root, especially, is sometimes edible and wholesome even in poisonous plants. The use for flavoring sauces, however, is suggestive of natural aromas preserved, though perhaps modified by cooking or combination.

Our coriander, of mal-odorous name, may claim the honor of belonging to both the spicy and the offensive classes, its name coriander (from Gr. *Koris*, a bug) announcing fresh odors suggestive of "bugs," especially in the green leaves, while the popular use of the aromatic dry fruits as a pleasant spice, indicates how much they have improved with age.

The more radical question of the uses of these peculiar products, to the plants themselves, is a curious and difficult one, though their prevalence through the family seems to mark them as something more than waste products. Both spicy and fetid products, and poisons, may serve to protect them from being eaten by animals, or by their antiseptic power may help to preserve them from decay. The vast family, however, is rich in useful expedients. Its habit of frequenting wet and partially

inaccessible waste places where little liable to be disturbed, its rapid growth, conspicuous massing of great numbers of minute flowers, and sudden production of immense numbers of hard and durable fruits well adapted to a wide dissemination, and sure to germinate in its damp haunts, and its protection, as we have found from various enemies,—all have contributed to its eminent success in life.

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### The Rhizocarps.

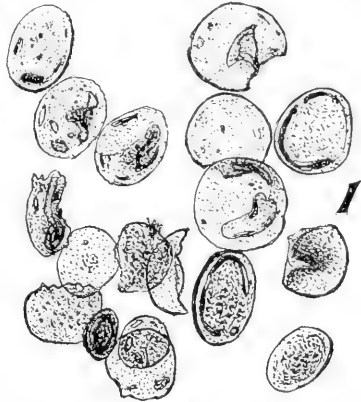
BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

Having lately received some slides and material which contained Rhizocarps from B. W. Thomas, of Chicago, Ill., and some papers on them from him and Sir J. W. Dawson, of Montreal, Canada, I thought that a knowledge of these microscopic atomies would be of interest. They are not generally known and they do not require very high power of illumination and obliquity of light to see them.

At the regular monthly meeting of the Chicago Academy of Science held Tuesday evening, January 15, 1884, a committee consisting of H. A. Johnson and B. W. Thomas submitted their report on the microscopic organisms in the boulder clay of Chicago and vicinity. They stated that while the lake tunnel for the purpose of supplying the city of Chicago with water from Lake Michigan, was in process of construction, specimens of the clay through which the excavation was made was subjected to microscopical examination (Fig. 1.) The results showed a disc, varying from 1-55 to 1-250 of an inch in diameter. They were dark brownish-yellow in color, and apparently flat or concavo-concave, and were unknown to any paleontologist to whom they were submitted. Slides were sent to New York and London without result.

The attention of Sir J. W. Dawson was first directed to these organisms, the Rhizocarps, by the late Sir W. E. Logan in 1869. He obtained from the Erian shales the Devonian of Kettle point, Lake Huron, specimens, filled with minute circular discs, to which he referred in his report of 1863, as "microscopic orbicular bodies." It was in a paper published by Sir J. W. Dawson in 1871, on 'spore cases in coal' that he first described the fossil remains in the slides which was intercalated with coal. These were the same from the Erian formation at Kettle Point

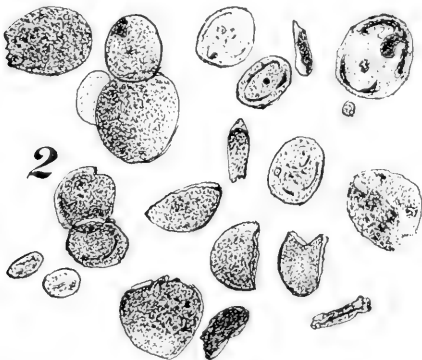


on Lake Huron, supposed to be on the horizon of the Marcellus shale in New York. The Marcellus shale is in the middle of the Devonian before the Carbonif-

erous coal came.

These remains are the minute brownish discs referred to. They were recognized as probably spore cases or macrospores of some acrogenous plants.

Acrogenous is applied to those cryptogamic or flower-



less plants, which increase by growth at the summit, or "growing-point," as the tree-ferns. The shales also contained immense numbers of granules, which most likely may be the escaped spores, seeds or macrospores.

The shale in which these discs were found contained bituminous matter and burned with much flame. There were also other small particles which were believed to be stems of a species of calamitès or fossil seeds.

In 1882, Prof. Edward Orton, of Columbus, Ohio, reported the finding of similar bodies in the Erian and lower Carboniferous shale of Ohio. At the same time Prof. Williams said he had found similar bodies in the Hamilton shales of New York. Prof. J. M. Clarke, of Northampton, Mass., subsequently reported the presence of similar bodies in the Genesee shales and the Carboniferous limestone. No certain clew, however, enabled Prof. Dawson to place them definitely in the flora of this early age. In March, 1883, specimens were found again in the Erian formation of Brazil, South America, by Orville Derby, which throw new light on the subject. These were found to contain along with Sporangites, abundant fronds of Spirophyton. The Sporangites of Brazil resemble in every respect the involucres or sporesacs of modern rhizocarps, and especially the sporocarps of the genus *Salvinia*, (a genus of the order of Hydropterides related to the club-moss family).

Quillwort is found on the bottom of ponds in New England, and *Azolla* is found in pools and lakes in New York to Illinois southward. *Salvinia natans* was said by Purch to be found growing on the surface of small lakes in western New York, but has not been found by any other person, and probably does not occur in this country, but the spores of *Azolla* can be taken as representing those of *Salvinia*, although they are covered with hairs whilst *Rhizocarps* are apparently smooth. The *Azolla* is much like a floating Liverwort and perhaps came by evolution from that plant. At all events spores of *Salvinia* are *Rhizocarps* and look like brownish bodies lense shaped and with a double outline. They have no marking upon them, but look like little round balls.

It was supposed that as they occur in countless billions they are the origin of bitumen, but this is not certainly proved. (Fig. 2 shows spore-cases of *Proto-salvinia* from Chicago boulder clay.)

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### EDITORIAL.

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**The Phipps Conservatory.**—Our first information regarding this institution comes from Mr. Logan, whose article introduces the present number of the Journal. It should be a great stimulus to biological research. The Pittsburg Microscopists will not be slow to improve the opportunity. Just as we go to press word comes that the following rare forms have just been identified there :

*Rhaphidiophrys elegans*, *Asplanchna brightwellii*, *Dendrosoma radians*.

**Governemental Delay.**—In 1888, six years ago, one E. F. Thomas, in the employ of the post office in this city stole some money which publishers had on deposit for the payment of second rate postage. The Department has just got around to refund the money. Mr. Conger a Republican politician, was postmaster in 1888. It was well-known for some time before his arrest, that Thomas was living fast, indulging in horse-race attendance, in drinking and in associating with questionable women, yet his accounts got into inextricable confusion before Mr. Conger looked after him properly.

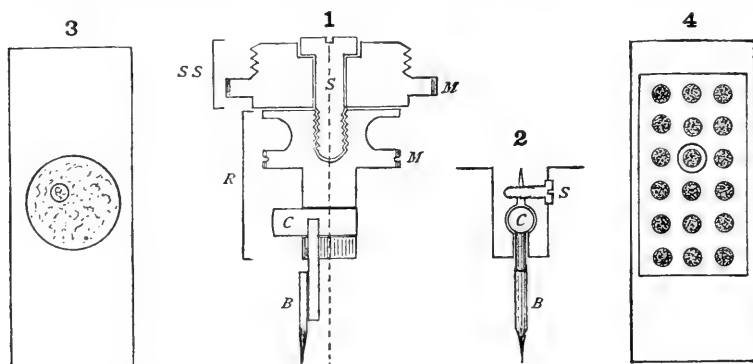
**The New Science Review.**—The third, or January issue of this attractive quarterly of science, fully keeps up the high standard attained in its two preceding numbers, and is likely to add to the favor with which the promising enterprise has been everywhere received. It contains several articles of notable character, among them one by Major-General Drayson, dealing with that subject of reform in educational methods which attracted so much attention to Mr. Jordan's paper on "Mental Training," in the October number. Grant Allen, in "The Amateur in Science," deals in his well-known sparkling manner with a side issue of the same interesting subject. The question of "What Electricity Is," propounded in the October number, has called forth a number of well written replies. Among the other articles are papers on "Union of Astronomy and Geol:

ogy;" Lord Rayleigh's consideration of "The New Element in the Atmosphere;" on "The Elseviers;" The Railroad in Asia;" and an account of "The World's Cables;" The "Reviews," is a new and important addition to the magazine.

### MICROSCOPICAL APPARATUS.

**Prof. Gage's Marker.**—A preliminary notice of this instrument was furnished on pp. 337-339 of THE JOURNAL, for November, 1894, but without the figure and description given below.

Fig. 1, is the entire marker in section showing the details of construction. SS is the upper part with society screw for insertion into the nose-piece of the microscope like an objective. R is the lower or revolving part carrying the brush, B. C is a mov-



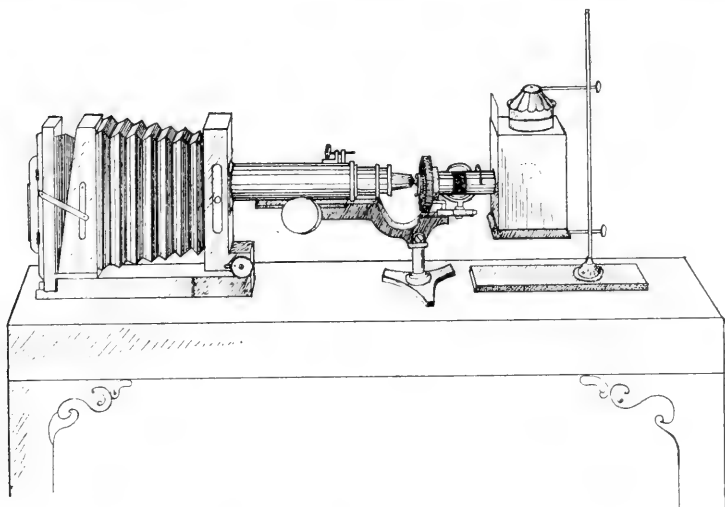
able cylinder by which the brush is made more or less eccentric. MM are milled rings on the society screw and the revolving parts. S is a screw connecting the two parts of the marker. The dotted line represents the position of the axis of the marker.

Fig. 2, lower end of the marker turned around 90 degrees to show the manner of insertion of the movable cylinder carrying the brush, B. S is a set screw for tightening the movable cylinder.

Figures 3 and 4, consist of slides illustrating the use of the marker. Fig. 3, is an ordinary circular cover with a ring showing where the part showing especially well may be found. Fig. 4, is a slide with a series of rings. The ringed section is the one showing a special structure most clearly.



**Dr. Shufeldt's Improved Apparatus for Making Micro-Photographs.**—I took my largest camera and placed it on a long table as shown in the sketch. I removed its lens and lens-boards, and fitted a cardboard front to take its place. Next I took my largest microscope—a Beck's Monocular National—and brought it into the horizontal position. I fitted the upper end of its body, while in this position, into the cardboard front



of the camera. A substage condenser, and a three-fourth inch objective were next attached to the microscope, and the camera and the latter coupled together. Now most micro-photographers omit using the eye-piece of the microscope, but with it I subsequently obtained the best results. It is inserted *after* the barrel or body of the microscope is run through the cardboard into the front part of the camera-box.

For an illuminator I used the dark-lantern of my photographic outfit—simply withdrawing the ruby-glass slide in front, and fitting in its place a thick piece of cardboard, into the center of which I inserted the lens from a small camera to act as a “bull’s-eye condenser.” This is coupled with the substage condenser on the microscope by means of a broad rubber band. My lantern I held nicely in the proper position by suspending it between the “rings” of a chemical standard, as shown in my sketch; but any simple device will hold your lantern up

in its proper place. It can even be "built up" by putting books under it. Both the lantern and microscope rest upon a very thin board which travels with ease on the extension-bed of the camera-box. By this latter simple contrivance, focussing your specimen on the ground-glass of the camera is easily managed.

**The Optical Axis.**—Dr. Sizer explains in the current issue of *The Microscope* why it is that many have trouble in photo-micrography. The optical axes require more attention than usual.

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### MICROSCOPICAL MANIPULATION.

**A New Fixing Fluid.**—Gustav Mann describes a fluid composed of absolute alcohol 100 cc., picric acid to 4 grms. corrosive sublimate 15 grm. Pieces should not exceed 1 cm. in thickness and are left 12-24 hours. Then wash in running water and place in 30 per cent alcohol with tincture of iodine sufficient to produce a brown color, for 12 hours, after which the tissue it hardened gradually in alcohol and imbedded in paraffin.

A shorter method is to wash in absolute alcohol for 10 hours changing the fluid at least once and then, after sectioning, treat the sections with iodide of potash solution. It is stated that the plasma and nuclei are well fixed with slight shrinkage and the cell outlines are well brought out. (*Anat. Anzeiger*, VIII, 12-23.)

**A Microscopic Clearer.**—Lenz recommends the use of a solution of sodium salicylate for clearing preparations for the microscope. This body has great advantages over chloral, as it very quickly transforms starch granules into a transparent jelly which is not disturbed by the addition of glycerin or water, and still turning blue with iodine. Further, it has less detrimental effects on the ordinary tissues than chloral.—*British and Colonial Druggist*.

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### BACTERIOLOGY.

**Study of the Organization of Bacteria.**—Mitrophanow (*International Ztschr. f. Anat. u. Physiologie*) examined the large pigmented sulfo-bacteria as chromatium, rhabdochromatium and ophidomonas, as also beggiatoa and allied saprophytes, crenothrix, spirilla, bacilli and bacteria. The living organisms

were stained with very dilute methyl blue solution. The sulfo-bacteria were very sensitive to its effects. One drop of 1 to 400 solution to one cc. of water sufficed to kill them. His researches led him to the conclusion that the bacteria are neither non-nucleated organisms nor organisms which consist exclusively of nuclear substance. They are cells of various complicated construction, whose nucleus is more or less separated from the protoplasm, of which it is a part. If the nucleus is not wholly separated from the protoplasm, the structureless Plasson of Beneden preponderates. If a distinct nucleus be present, it appears as an axial structure, containing several chromatin bodies. Beside a nucleus there are granules in the protoplasm, which he regards as morphological evidences of cell life.—(*St. Louis Med. and Surg. Jl.*)

**Dirty Bakeries not Unhealthy.**—Mr. H. S. Young has published in the *Bakers' Times* the statement that although thirteen loaves were microscopically examined by him, no trace of living bacteria or an actual spore, was found in any loaf after its removal from the oven, and this, too, when the temperature of the inside of the loaf was below 203 degrees. It is further shown by Mr. Young that a loaf from a low-class, dirty bakery does not contain more bacteria or spores than are to be found in a clean bakery. These facts tend to prove that baking sterilizes such germs as may exist in the flour, etc., so that whatever other articles of diet may be condemned on account of unhealthiness, bread may continue in popular favor.—*Science Siftings*.

### MEDICAL MICROSCOPY.

**Tuberculous Milk.**—Dr. F. O. Donahue, president of the New York State Board of Health says of the examination of milk supply for tuberculosis that the statistics of New York State show tuberculosis to be the cause of one-eighth of the deaths, and it was not questioned that many of these cases of consumption originated from tuberculous milk. Since 1892 there has been a law in New York State providing for the slaughter of cattle found to be suffering from tuberculosis.

Examination of animals immediately began, and out of 22,000 examined cattle 700 were ordered to be killed. The fact that there were so many diseased cattle was sufficient to require

the formation of a special commission to inspect the milk supply, which has not yet made any official report.—*Iowa Health Bulletin*.

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### DIATOMS.

**Studies in the Biology of the Diatoms.**—The Diatom considered as a Protozoan, by K. M. Cunningham, (*The American Monthly Microscopical Journal*, No. 7, July, and No. 8, August, 1894). In the two above mentioned articles, the author attempts to prove by a series of demonstrations and experiments, that the diatomaceæ belong not to the vegetable kingdom, but to the animal kingdom, to the protozoa; that is to say, he brings us back to the time where incertitude was great concerning the place that these organisms ought to occupy in nature. Will Mr. Cunningham succeed in bringing back on the carpet that old question of the animal nature of the diatomaceæ? I am doubtful about it.

These two articles are certainly very interesting to read, but I found in them nothing new to prove in an irrefutable way that the diatomaceæ are animals.—J. Tempere, in *Le Diatomiste*.

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### MICROSCOPICAL NOTES.

**The Infinitesimal.**—The domain of the infinitely minute is a broad one. It was lately stated at a scientific meeting that a single drop of ether thrown on the floor of the laboratory, would entirely prevent the success of experiments illustrative of certain electrical phenomena. A pin-hole in the door of a photographer's "developing" room will ruin his freshly taken plates.—T. W. NUNN, in *The New Science Review* for January.

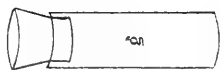
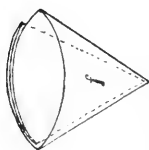
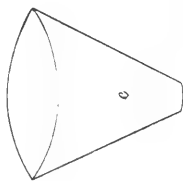
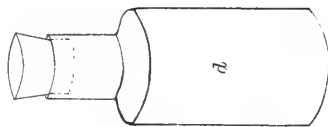
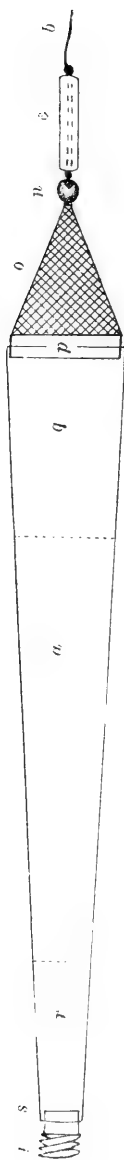
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### NEW PUBLICATIONS.

*Recent Medical Publications.* P. Blakiston, Son & Co., Philadelphia.

This catalogue is presumably for free distribution to those interested enough to ask for it. It includes Abbott's Bacteriology and Beale's Biology of which we have not yet seen copies; as well as Reeves' Medical Microscopy which we have as ready mentioned as the latest and best of its kind.





COLLECTING NET AND APPURTENANCES.

WARD

# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

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FEBRUARY, 1895.

No. 2.

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### Improved Methods of Collecting Aquatic Micro-Organisms.

BY R. H. WARD, M. D.

TROY, N. Y.

[Remarks at the Microscopical Section of the Troy Scientific Association, December 3, 1894.]

During a visit last summer to the laboratory of the Michigan State Fish Commission, at Charlevoix in that State, I became greatly interested in the investigations there made as to the food fishes, and other subjects and interests more or less directly connected with their abundance, preservation, etc. After the close of the laboratory, I gladly availed myself of the suggestion of its Director, my son Prof. Henry B. Ward, to make collections from the inland lakes and their tributary streams, to the northward from that point, as a supplement to, and for comparison with, the work in Pine Lake and the neighboring portions of Lake Michigan, that had been done directly from the laboratory. To this end, I visited Bear Lake, a most picturesque sheet of green water and river-like aspect, south of Petoskey; Carp Lake, a delightfully quiet outing resort south of Mackinaw City; and the devious succession of connected lakes (Crooked, Burt and Mullet) and rivers (Crooked, Indian and Cheboygan) which extend from Conway, close to Lake Michigan, to Cheboygan on Lake Huron, and which make the whole district northward to the Straits of Mackinac almost an island. The rivers, however, are but little brooks, and the crossings of them are so insignificant

that travelers would not easily suspect that they had left the mainland. All these lakes are as beautiful as they are secluded, in the midst of a quiet forest region; and, in fact, the whole peninsula from Traverse City to Mackinaw is little more or less than a great summer park, or national pleasure ground, which constantly reminds one of the non-mountainous portion of the Adirondack wilderness, and which might be almost described by calling it the Adirondacks of the West. A more agreeable, salubrious or generally available region for summer relaxation or for biological studies could scarcely be imagined. Obviously the fishing interests of such a region are very great, not only in relation to food supply, but as a prominent attraction to visitors. And it is believed that the rich and interesting collections made on this occasion and which have been turned over to the specialists of the laboratory for study and comparison, will be of value as to the questions of food supply for the fishes, and therefore of the capacity of the lakes for their breeding and maintenance.

The present object is to explain some improved methods that were devised for collecting samples of the minute crustaceans, worms, protozoans, algæ, etc., that inhabit those waters. The earlier apparatus for collecting such microscopic organisms, which were then called infusoria, were little nets, drags, knives, hooks, vials, spoons, etc., with attachments to canes or other handles; which we tried to use a score of years ago, but which proved to be little more than ingenious toys, and which have long ago been relegated to the sphere of curios, having been superseded by far more efficient instruments.

Probably the best of the modern collecting nets is the one contrived and introduced by Prof. E. A. Birge, of Madison, Wis. In this system a comparatively large net ( $q$ ,  $a$ ,  $r$ , in the Fig.) is dragged through the water, its front end, and entrance, being protected with a con-



ical brass screen (*o*) of woven-wire, with meshes of 1-16th inch. This, being mounted with its point forward, readily cuts through beds of weeds or any obstructions amidst which the net could possibly be used in any way, allowing free entrance to the water and micro-organisms (and, unfortunately, to fine sand or soft mud), but excluding weeds, stones or coarse rubbish of any kind. The net (*a*) is made of fine cheese or bolting cloth or some muslin or lawn of suitable texture, and is strengthened by being made of double thickness for a few inches at each end (*q*, *r*); and as water passes in at "*o*" and out at "*q*, *a*, *r*," under pressure of dragging the net forward through the water, the contained organisms naturally accumulate within, at the rear end, whence, after removing a screw cap (*t*) from a 1-inch tube (*s*) inserted in that end, they are to be washed out into a bottle. This net was suitable for microscopic forms, from Cyclops to diatoms; for large insects, fish spawn, etc., a coarser screen and more open cloth would be used, according to what one wished to fish for; while a coarser screen and fine lawn would take everything, including much rubbish.

As I have seen this net used, a cylinder of sheet copper, not unlike a bit of stove pipe four inches in diameter and of twice that length, connects the conical screen with the mouth of the net. This cylinder may possibly make the net less liable to entanglement or tearing when thrown out from shore among thickets of coarse weeds, to be drawn back again by its tow-line, as is sometimes done in the absence of a boat. But for the sake of portability, and also hoping to secure a more manageable implement, one was made, as shown in the Fig., without the cylinder, the net (*a*) being fastened to a hoop (*p*) of sheet copper, 4 in. in diameter and  $\frac{3}{4}$ ths in. long, soldered to the base of the wire screen-cone (*o*); the net-edge of the hoop being turned up over a wire, as the edges of tinware are often protected, which stiffens the hoop and makes it impossible for the net to slip off

after being firmly bound on with fine twine. The ring (*n*) for the attachment of the tow-line is of  $\frac{1}{8}$ th in. brass wire, the ends of which are carried down within the cone and soldered, at opposite sides, to the inner surface of the copper hoop (*p*); all the connections and joints from "*n*" to "*p*" being carefully soldered so that nothing can enter the net except through the meshes of the screen. This whole arrangement was found to be light, convenient and practicable beyond anything that I had used before, or had seen used in the most experienced and capable hands.

By far the most efficient service that can be attained with this apparatus in most localities is accomplished by sitting in the stern of a row-boat and towing the net by its line (*b*) held in the hand ; giving more or less line, or causing the speed of the boat to be varied, according to the degree of immersion required, suddenly slacking the line for a second or two to allow the net to dive into a weed bed when desired, or suddenly drawing it forward enough to cause it to rise above some source of danger, or away from patches of weeds when clear-water forms are being collected, steering it to one side or the other of the boat, or even drawing it to hand occasionally, in order to throw it out into weedy patches at the side of the boat's course. By such management, one can make the apparatus almost an instrument of precision, and can gain more of that exhilarating recreation that comes with an exercise of care, adroitness and skill than he would find in trolling for pickerel or in sailing a cat boat.

The brass cone and its hoop at the mouth of the net are heavy enough for most purposes ; but if additional weight be required it may be added in the form of a lead sinker, which is perhaps better than making the original construction heavier, as it is capable of variation when desired. A longitudinally perforated cylinder of lead, 13 mm. thick and 75 long, weighing 1-4 lb., as sometimes

used for sinkers upon a seine, is a convenient form which may be readily strung upon a cord and tied upon one side of the copper hoop when "fishing" by casting out from the shore, or be tied at the tip of the screen-cone for towing from a boat. In the latter case the lead may be simply strung upon the tow-line, and so fastened that it cannot move away from the net, as shown at "c;" after the first trial of which plan, the net worked so well that I was not tempted to return to any one of the many other arrangements that had been tried.

There is no difficulty in towing the net in mid-water, one or more meters below the surface, or near the bottom where that can be readily seen, and the net be guided accordingly. It may also be dragged freely upon the bottom if that is hard, or is protected by dense weeds. On a soft, muddy bottom, or on sand that is easily stirred up, and fine enough to pass readily through the 1-16th in. meshes of the screen, it is evident that this or any similar arrangement will be overwhelmed with waste material. The expedient of suspending heavy sinkers from the hoop of the net, by strings that allow the net to remain some inches above the sinkers when they are dragging upon the bottom, was tried with some degree of success; but any such arrangement is precarious when the net is out of sight, and it is evident that for such use, if desired, the net should be enclosed in a cylindrical framework or cage of stiff brass wire, so designed that, however it may fall, it will always lie upon some two longitudinal wires as runners, upon which it will be supported and will glide like a sled, as is done in some of the larger apparatus employed for similar use from steam or sailing vessels.

As soon as one collection which is to be kept by itself has been completed, the material accumulated should be transferred into one of the wide-mouth, (about 4 or 5 oz.) wash bottles (*d*) provided for the purpose. The net is to

be raised rapidly from the water at the side of the boat, and held suspended from its tow-line until it has emptied itself of water, mostly of course by percolation through the lower portion of the cloth; it is then soused in the water again and lifted as before, and after repeating this procedure three or four times the solid particles have nearly all been washed down into the tube at the bottom and into the adjoining portion of the net. This portion, still held vertically, and with the tube (*s*) full of water, is then brought over the edge of the boat, and held over one of the wash-bottles while the screw-cap (*t*) is carefully removed, and the water with most of the organisms allowed to fall into the bottle. If the collection be small or for other reason it be desirable to save as much material as possible, the cap is securely screwed on (not dropped overboard), the net soused again, and the washing-out repeated; and so on until the water comes clear from the net. If, unfortunately, the screw-cap should be lost, one of the muslin filters can, instead, be tied over the end of the tube (*s*); but it would be inferior in safety, and, as the whole collection will not adhere to this filter, the other procedures would still be necessary and would be performed at a great disadvantage. It is therefore better, if one fears the loss of the cap, to connect it with its tube (*s*) by a few inches of strong twine, arranged slack, so that the cap can be unscrewed but cannot be lost. The cap and tube are the common kerosene-can top, to be obtained at any tin-shop.

Of course the net and screw-cap are thoroughly rinsed before and after each collection, the organisms from marshy shores or weedy beds or streams, where most will be obtained, being kept carefully separate from those of the clear water; and in the latter case those of the surface and deep water being kept apart, and the hour of day and state of weather being carefully recorded, as essential to an understanding of the distribution and

habits of the various creatures. The determination of the exact amount of "plankton," by which is meant the totality of the micro-organisms floating free in any portion of the lake, from top to bottom, can of course only be made by a different sort of net with apparatus to give it a vertical instead of horizontal motion.

When collections are to be made only in three or four localities, to be worked over in the laboratory within a few days, they may well be kept in the bottles as thus described. But in longer trips when several dozens of collections are to be made, or in any case when the material is to be kept long on hand before receiving attention, and would therefore die and decay, it must be condensed by straining out the surplus of water, and transferred to small vials (*g*) containing diluted alcohol of about 70 per cent with or without traces of picric and hydrochloric acids or of acetic acid and corrosive sublimate, or such other killing or preservative fluid as may serve the purpose for which the material is to be used. The 4- or 6-dr. cylindrical vials used for pocket medicine cases are best for this purpose; those made with full-width mouth, without a neck, being much the most convenient to fill, though awkward to pour from, and on the whole preferable when they can be obtained strong enough for safety. Those with screw caps, lately introduced, would be doubly convenient if not more liable, as most of them are, to breakage or leakage.

The method of straining away the surplus water has been to pour it into a small funnel plugged at the bottom, and furnished above the plug with an area of fine wire gauze through which the water could ooze very slowly, the filtrate at last remaining adherent to be removed with much difficulty. As this method was impracticable for the amount of work which I intended to do in the field—or rather, in the boat—it was abandoned, and straining through thin muslin filters, made of the

same material as the net, was substituted. These were made 3 in. in diameter, cut round like chemical filtering papers, and used in a similar manner; and they proved very satisfactory. They are carried between the pages of the note book, or otherwise kept clean and smooth; and, when required, one is suitably folded (*f*) and placed in a little tin or copper funnel (*e*)  $2\frac{1}{2}$  or 3 in. in diameter, from which, for convenience, the tubular portion below has been melted off, only the conical portion being useful. Through the strainer thus made, held over the edge of the boat, the contents of a bottle of washings from the net can be poured more rapidly than would be expected. When the material is very abundant, the organisms accumulating on the filter by the teaspoonful, as much as is required is to be transferred to one of the numbered vials of alcohol, and the filter is thrown away; but if the quantity be small, it and the filter are put, together, into the vial for future examination, taking care not to crush the objects by careless handling. By pouring from the wash-bottle immediately after stirring it, nearly all the organisms can be transferred to the filter, and most of the sand, if any, left in the bottom of the bottle.

All the apparatus required for a week's collecting may, except the net, be carried in one's pockets, and when in the boat be spread out upon or under the seat; but it is very convenient to have a suitable case, such as a small, satchel of leather or canvas, the latter being less liable to defacement by a slight wetting, arranged to hold safely and display easily the following apparatus:—(*a*) the net, complete, with tow-line (*b*) and sinker (*c*) attached; (*d*) three wash-bottles, corked; (*e*) the funnel; (*f*) a supply of filters, twice as many as the numbered vials, to allow for emergencies; (*g*) an adequate supply, numbered in regular series, of vials for the specimens, each being half or three-fourths full of the required preservative fluid; (*h*) a pair of small forceps to assist in

handling the charged filters and in getting them into or out of the vials; (*i*) a sounding line and lead; (*k*) a compass, and hand lens or microscope unless these be carried in the pocket; (*l*) a note book and pencil; and (*m*) some extra sinkers and string, a needle and thread for repairing the net if torn, and for long trips an extra net (the cloth part), in reserve.

With such an outfit, and the Michigan lakes to "fish" in, a few weeks of summer vacation can be spent with equal profit and pleasure.

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### Diatoms of the Connecticut Shore.—VII.

By WILLIAM A. TERRY,

BRISTOL, CONN.

Early last season, I visited Leete's Island to complete observations commenced the previous season. At low tide at Shell Beach, there is a broad expanse of soft mud laid bare below the sands; this mud just before the return of the tide was covered with a brown film that I recognized at once as being composed of living diatoms. On examination the microscope showed that these were chiefly three different sizes of naviculoid diatoms aggregated into separate colonies, the smallest form being so minute that a power of 500 diameters was needed to definitely show their outlines; the next size being about double their linear dimensions, and the third considerably larger and showing the crossband of a *Stauroneis*.

I took a small fragment of the film about 1-10 of an inch in diameter and separated and mixed it with a few drops of salt water; then took one drop of this and placed it on a slip and covered with an inch square cover glass. Under the microscope, this showed the film broken into minute pieces in which the diatoms were packed in solid masses, each kind separately, and were motionless; but thousands of each variety were diffused through the

water and these were very active, showing their characteristic motions and their usual color. On counting the diatoms in the field of view in various parts of the slide, I estimated that this drop contained over 250,000 individual diatoms; and as this was less than 1-5 of the fragment of film under examination, I thought it safe to conclude that each square inch of this film contained over one hundred million diatoms. As the area covered by this sheet of living diatoms was about 20 rods in width and some 80 rods long, the number of individuals composing it may well be reckoned inconceivable. I had previously found aggregations of similar diatoms covering a space of several feet in diameter, and had been duly impressed by their prodigious numbers, but anything like this I had never before seen. An acid treatment soon demonstrated that the two smaller kinds did not possess any silicious covering. They were as easily dissolved and destroyed as desmids would have been by the same treatment; the larger kind, however, survived the operation and proved to be very small specimens of *Stauroneis salina*.

The soft ooze upon which rested this immense sheet of living diatoms, and from which they had separated themselves and climbed up to enjoy the sunlight as soon as the water had receded, was itself rich in varieties of nearly all sizes; but as these have been named in previous articles of this series in describing the diatoms of Shell Beach, it is not necessary to specify them here. The mud was also exceedingly rich in varieties of microscopic animals.

Two weeks later I visited Shell Beach again, and found a similar brown sheet of diatoms spread over the mud; but examination showed important changes. The two smallest forms had nearly disappeared, being found only in small patches here and there; the bulk of the film being composed of two different sizes of *Stauroneis*



salina, one being the same size as those previously found, the other considerably larger. *Stauroneis salina* is common all along the Connecticut shore, but I have never previously found them abundant in any one gathering. The common form is many times larger than these in this living film. Parts of this film now showed large numbers of *Pleurosigma*,—*P. fasciola*, *P. affine*, *P. angulatum*, *P. decorum*, and *P. balticum* being abundant.

Crossing over Leete's Island, I found Great Harbor Beach showing only a few patches of brown film from six to ten feet in diameter. These were generally similar to that on Shell Beach, but on the north side of the harbor I found one in which *Pleurosigma fasciola* was accompanied by an equal number of a form I had never before seen. This was cylindrical and straight, both ends tapering down to a hyaline prolongation which was tipped with a small knob. By holding a frustule of *P. fasciola* so as to give an edge view with a linear outline, it closely resembled the new kind but was only about two-thirds as large. Both were very active, swimming about with ceaseless activity, and at about the same rate of speed. The new kind proved to be destitute of silex, being completely dissolved by acids.

Two weeks later the sheet of living diatoms still covered the mud at Shell Beach at low tide. It was now composed chiefly of the larger *Stauroneis* with *Pleurosigma* in greater abundance, and was of sufficient thickness to be separated from the mud and rolled up into floating masses by the advancing tide; two months later, in September, the brown film had entirely disappeared, low tide showing only a broad expanse of soft mud.

West of the depot at Branford, a new bridge had been built. In digging for the foundations a large amount of marine deposit had been thrown up which all contained diatoms. Part of it was quite similar to the upper stratum at Leete's Island which showed *Navicula didy-*

mus and related varieties, another part showed *Surirella febegeerii* with numerous other varieties which were shown by the twelve foot stratum at Leete's Island. Much of this marine deposit is not rich, but it all contains diatoms. Silver Sands is a watering place about two miles east of Light House Point at the entrance of New Haven Harbor. Between these two places stretches a salt marsh divided from the waters of the Sound by a bank of sand thrown up by the sea, which I should judge to be from two to five hundred feet wide, and several feet higher than high tide.

The waters of the marsh communicate with the Sound by means of Morris Creek near Light House Point and two small creeks at Silver Sands. I procured material from the marine deposit underlying this marsh at several points, and found it contained diatoms in most respects similar to those of the deposit at Leete's Island, but with some differences. Instead of the *Navicula maculata* so plentiful at Leete's Island but which was very rare here, it had many more specimens of *Navicula latissima* and related varieties. *Cerataulus polymorphus* and *C. turgidus*, with *Biddulphia pulchella* were much more abundant and varieties of *Auliscus* were also more plentiful.

At about four or five feet from the surface I found a stratum containing rather more numerous varieties than any previously described in which were mingled both deep and shallow water kinds. The upper stratum in all these marshes that is penetrated by the roots of sedges and other marsh plants, nearly always contains numerous varieties of *Navicula constricta* or *Diploneis*, and also many varieties of *Navicula elliptica*. Below this are strata with *Pleurosigma* and *Campylodiscus*, then comes *Coscinodiscus* and *Actinoptychus*. The strata sometimes alternate so that shallow water kinds are found below those containing only deep water varieties.

At six or eight feet depth the shells of oysters and other marine animals are often abundant.

This marine deposit is conclusive proof that all these marshes were once open water; the huge bank of sand that now prevents the waves from flowing over them is a superficial structure lying on top of the marine deposit which projects through it, and shows at low water as a bank of mud some three feet higher than the surface of the water at low tide, and extending downward to a varying depth and outward into the open water; in some places it can be traced outward for nearly a mile or until the water becomes too deep to follow it. The upper layers of this ancient mud, where it shows on the steep face of the sandy beach, are filled with roots of sedges and contain the same varieties of diatoms as the upper stratum beneath the marsh. In fact this stiff mud continues in an unbroken sheet from far out in the open sound back to and through the ridge of sand forming the beach and under the entire surface of the marsh. This shows that these marshes were once much more extensive than they are at present, and that the sea has been for a long time at work driving back the sandy beach and washing away the surface of the ancient deposit. This fact introduces an element of uncertainty into our study of recent marine diatoms.

I have pointed out in previous articles that the presence of even an abundance of fresh water diatoms in a marine deposit, is no proof that fresh water had ever existed near that locality; the diatom being brought down in abundance during high freshets in creeks and rivers, and distributed over vast areas by the action of tides and storms. It might be supposed that soundings, and gatherings of recent soft muds, would contain only recent varieties; but when we consider that hundreds of acres of ancient deposits have been washed away to a depth of from six to twenty feet, and that there is a core-

sponding surface now exposed to the wear of tides and storms, it will be seen that there is at least a chance that some of these ancient diatoms are mingled with our recent gatherings; and that it is possible that rare and curious finds instead of being the product of yesterday, or even the blind imprint and effigy of former life, may be themselves the very individual forms that once instinct with life and vigor were swimming in these seas before the dawn of history.

The pond holes in the salt marsh between Silver Sands and South End were very numerous, but most of them were shallow and probably dry at certain seasons, and I did not find them to contain anything of special interest; but two of them just back of the beach were deeper and were exceedingly rich in diatoms, *Pleurosigma balticum* var. *maxime* being the most abundant; varieties of *Amphora* and of *Amphiprora* were also numerous and many others similar to those that have been previously described as inhabiting such locations. *Actinocyclus crassus* is common all along this part of the Connecticut shore, and *Actinocyclus barkleyi* is found here; but as this marsh connects on the west with the marsh bordering on Morris Creek, and as this creek is probably the most prolific habitat of *A. barkleyi* that has ever been discovered, its presence might be looked for here. A living specimen of the very large *Amphiprora* of these marshes is a remarkable object of observation. When one of these diatoms pushes into the field of the microscope, ploughing up the debris before him and filling up nearly the entire field of view, and passes on sweeping every thing before him; you may possibly consider him a vegetable, but never a plant. All the *Pleurosigma* also when healthy and vigorous are very active; almost any of them are able to surpass the most rapid steamboat in relative speed. For some years past I have not found the beautiful red algæ that used to be abundant on these

shores ; but this year in September I found at Silver Sands, *Grinnellia americana*, several peculiar types of *Dasya elegans*, *Lomentaria baileyana*, *Callithamnium baileyi* and *corymbosum* with several other varieties, *Polysiphonia violacea* and *olneyi* and many others. Large quantities of aged specimens were thrown up on the beach ; some days I saw two men with horse and cart at work for several hours piling them up above high water. This pile contained abundant specimens that had been beautiful when young, but now were faded and black ; and so covered with growths of hydroids as to give the whole pile a gray tint. Off the beach at Morris Cove, *Polysiphonia violacea* and related varieties were plentiful. West of New Haven Harbor at Hine's Point and at Merwin's Point near the village of Woodmont, I found the red *Ceramiums* and *Callithamniums* plentiful, and red *Polysiphonia* unusually abundant.

I took samples of earth from four and five feet below the surface of the marsh between Savin Rock and Waverly Grove and found them rich in varieties of diatoms similar to those from Silver Sands, but containing an even greater number of kinds of *Cerataulus*, *Biddulphia*, and *Auliscus*. Similar samples from the marsh back of Woodmont also showed an increased number of these species, and soundings from the creek were rich in *Navicula permagna* of the normal type, which is somewhat rare here. The specimens so plentiful at Leete's Island are a different variety of this species. I investigated more or less closely about 25 miles of shore line, but as my examination of samples is not yet completed I do not give lists of species in this paper.

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**Gallic and Tannic Acid Tests.**—To a solution of tannic acid, add solution of chloride of barium and a pink precipitate will result, gradually darkening. To a solution of gallic acid, add a solution of potash and of chloride of barium and a blue precipitate will result.—*Fred'k Davis.*

### A Substitute for Spring Clips.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

I have an old microscope, an upright one, one of the old French pattern, in fact it is the same as I first possessed over forty years ago, with achromatic lenses, dividing, which has a stage with a fine adjustment fixed to it.

Last spring, I was using it as a finder for certain low power objects. There were no spring clips to the stage by means of which the object could be fixed. This does not so much matter when the microscope is upright, but even then when using a lens of about one-half inch focus it is difficult to fix the object. No matter how careful you are the object will slide out of the way when you let go of it. The movement is not easy and when a mechanical stage is used it becomes impossible to fix it entirely.

Under these circumstances, I contrived the following apparatus. I find it very useful and so I describe it for the benefit of those who are also in want of something of the same kind.

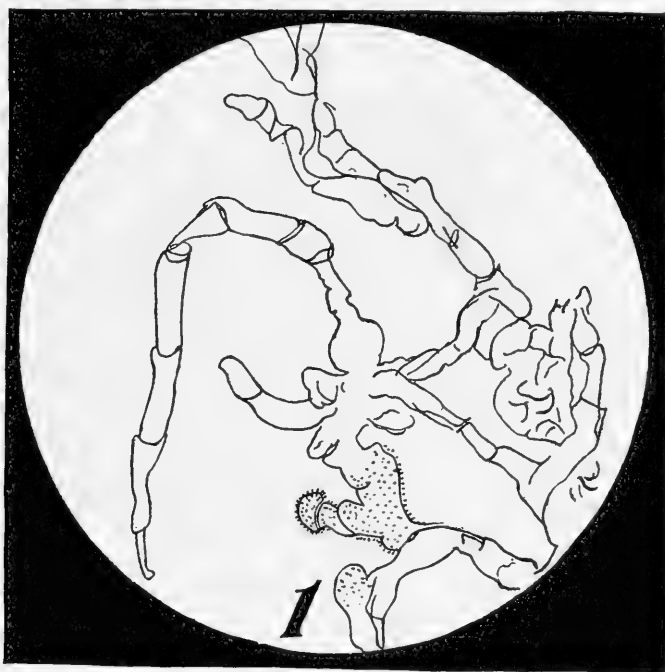
I cut with a strong pair of scissors a strip from a corset steel. Now this is poor steel but it cuts rather easily and bends nicely. This strip is about as wide as the spring clips usually are on the stages of microscopes, that is to say a little wider than an eighth of an inch. This is bent until it forms a spring. One end is rounded off and this end is for the spring to fasten down the slide to the stage. The other end is carried under the stage flat to the opposite side of the stage. The whole is bent down until it forms a spring. In this way an excellent spring clip is made and I really found it very serviceable. This is a cheap spring clip, for it cost nothing except the labor of cutting and the old corset spring.

## Mould and Other Growths Found in the Seed Cavity of Apples.

By L. M. MOOERS,

TAKOMA PARK, WASHINGTON, D. C.

In the American Monthly Microscopical Journal for January, 1894, appeared an article by Dr. A. C. Stokes, entitled "A Mouldy Puzzle" in which he describes the appearance of a certain growth found in the core cavity of apples and which he characterized as a "fungus."



White growth from wall of seed-cavity of an apple.

I had often noticed this growth, without giving it any special attention, but upon reading Dr. Stokes' article and seeing a chance to "puzzle it out" and make myself famous, I began to hunt for the spores and for the mycelial threads outside the core cavity which he says "must be there." While I rarely failed to find the

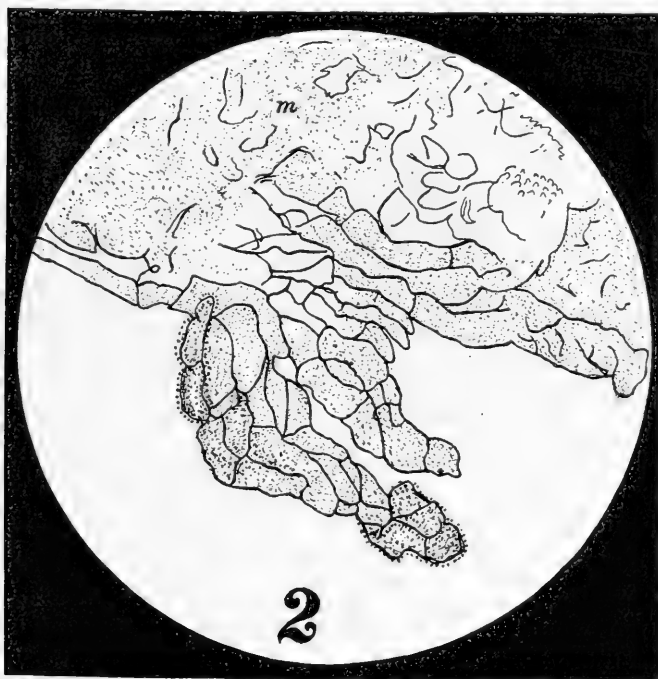
cottony growth I did not succeed in finding either spore or mycelium and began to doubt whether they really existed at all. The growth appears as Dr. Stokes describes it, as white cottony patches springing from the inner surface of the walls of the seed chamber or running over them in fluffy ridges, and also investing the coats of the seeds. Under the microscope it appears as a mass of more or less elongated cells, many of them being drawn out to most abnormal lengths and usually studded with minute papilliform bodies. While the appearance of the longer cells closely resembles threads of mycelium, the manner in which they grade into the normal cells of the apple body would alone seem to preclude the idea of a fungous origin. In their manner of occurrence, nature, and appearance, they more closely approximate plant hairs than any fungous growth. Having gotten thus far, I called on Mr. Galloway, chief of the division of Vegetable Pathology, Department of Agriculture, who had recently had his attention directed to this same matter, and not only had my own conclusions that the growth may properly be regarded as internal plant hairs corroborated, but I learned still further that the cells usually start from the walls of the seed cavity, growing in and surrounding the seeds, but may also start from the seeds. I learned also that the papilliform bodies studding these cells are quite common especially on internal hairs such as those in the intercellular spaces of various plants,—the white water lily being a good example.

While examining the growth just considered, the common blue mould so often seen in the core cavity of apples invited my attention as to its manner of gaining entrance. A short article in the *Agricultural Gazette* of New South Wales, for June, 1891, says of it under the heading,—“Mouldy Core:”

“This is a diseased condition brought about by the



presence of common mould in the core which gains entrance through an open pip. Ordinarily only apples with open pips are liable to the disease. The spores of common mould coming in contact with the surface of an apple with an open pip first adhere, then germinate and send their threads into the pip-hole and thence into the core cavity. Here the threads grow and fructify until



Cells from white growth on seeds of an apple.

m. A thick part of the mount.

they finally attack the pulp which attack is accompanied by a brownish rot."

I examined some 300 out of a lot of three barrels of rather imperfect apples and made notes of the results. Apples of the same variety vary greatly as to the condition of the pip or blossom end—both while growing and

after being stored. A perfect pip presents no opening into the body of the apple, while those termed "open" are spreading, broken down, cracked more or less deeply and often show that they have been the door way through which some marauding worm has entered. But open pips do not account for all the mouldy cores, in fact, they account for only a small portion of them. Worms often enter the apple by way of the pip, oftener perhaps than from other points, and they are the parties responsible for most of the mouldy cores.

The spores of mould are universally disseminated and wait only a lodgment and the proper conditions to germinate and produce their kind again. The apple pip forms a good collector of the floating spores and from it they are carried into the apple by the first worm that enters, and once in they do the rest. Apples are subject to the attack of worms from the time the petals fall away and the calyx begins to enlarge to its maturity, and in especially wormy years it is not uncommon to find 50 per cent or even more of the product of an orchard thus injured. Out of 100 apples without worm holes, 99 showed no mould in the seed cavity, and one with no opening that I could discover did contain it, but I am quite sure in the light of subsequent results, that with a more careful examination this seeming exception would have been no exception, but could have been folded with the other ninety and nine that went not astray. Twenty-five with worm holes by way of the pip into the seed cavity all showed mould, six with pip broken down and containing spores but no opening extending into the seed cavity showed no mould. I found two that had been stung while quite young by some of the curculio tribe but otherwise sound. The wound made by the puncture showed a hardened, slightly darkened tract, the center of which contained a white growth but not extending to the seed cavity which was free

from mould. In falling from the tree apples are frequently penetrated by stubble making wounds called straw holes. These I have found mostly filled with mould and if penetrating to the seed cavity, investing it also with the same growth.

I have found exceptions to this, however, in which the straw had penetrated to the seed cavity and no mould followed, but the reason for this seemed to be in the nature of the wound, the straw still remaining and really leaving no opening between the seed cavity and the outer air. My examinations began in February and continued well into April, or as long as my apples lasted, for by this time they were decaying badly. Those with spots of decay beginning at the surface and extending only partly through the body showed no mould in the seed cavity, but where the decay reached the core mould usually followed. Those entirely decayed were covered with numerous colonies of mould which invariably invested the seed cavity.

The growth of which I have spoken as "common blue mould is *Penicillium crustaceum* instead of *Aspergillus glaucus* as I at first supposed, the latter being a stage of the common herbarium mould, *Eurotium herbariorum*.

To summarize: The cottony growth is a modification of the normal cells of the apple.

The cells that grow out into hairs, belong more particularly to the walls of the seed cavity than to the softer parts, but it is difficult to draw a line between these two classes of cells as they grade so closely into each other.

The spores from which originates the blue mould found in the seed cavity may fall upon any part of the apple's surface. If lodging in an open pip, or blossom end, they may germinate and send their mycelium into the seed cavity where fructification is completed. Open pips account for but a portion of mouldy cores.

Apple-worms entering from any point may carry in the spores on his body. When the entrance is made by way of the pip, mould almost invariably occurs.

Apples having broken-down and enlarged blossom ends containing spores but without an opening to the seed cavity showed no mould.

Any opening through which spores may gain the seed cavity may give rise to mould.

More mouldy cores result from the entrance of worms than from any other cause.

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### Some Observations on the Behaviour of a Mixomycete.

By THOS. CRAIG,

STATEN ISLAND, N. Y.

In Bennett & Murray's book on Cryptogamic Botany mention is made of this form of life as the sixth sub-division. It is placed between the fungi and the proto-phyta; but at the end of their description they say: "We are justified in placing these organisms outside the limits of the vegetable kingdom."

Dallinger, in his edition of Carpenter on the Microscope, places them in the animal kingdom, in close affinity with the rhizopods. Saville Kent, after prolonged investigation placed them in the animal kingdom. All these writers follow De Bary, who in 1859 first published the results of his researches and his conclusions that they were more allied to animals than plants. De Bary's conclusions were fully confirmed by Saville Kent, who traces the development as follows: Suppose the existence of a sporangium; this bursts and liberates the spores which in the presence of water give birth to a globular protoplasmic body, which becomes after a time a flagellate infusorian, capable of ingesting solid food. It then loses its flagellæ and becomes an *Amaba*. Two of these conjugate and attract a number of other

like bodies, or become joined to them in some way not understood. These form what is called a plasmodium, a portion of which can be seen under the microscope. This plasmodium is capable of apparently voluntary motion. It goes forward and retreats by a flowing motion carrying embedded in its substance various species of algæ which it has captured as food. There is a remarkable resemblance in the mode of movement between the myxomycetes and the proteomyxa: the same flowing motion of the protoplasm and the joining of the filaments to form larger ones.

The reason for the foregoing prelude is that during the month of February 1894 I was watching one of the myxomycetes—which had developed in some water taken in the Old Town pond—into what may be called its animal stage. In the glass jar in which it is growing it resembles a miniature tree of many branches, flattened against the glass. Before it made its appearance the glass jar was so covered with growth of algae that one could not see through it. As soon as the myxomycete made its appearance and had traveled a short distance, the glass on that part over which it passed was comparatively clear. Now that the myxomycete has gone several times round the jar, the glass is quite transparent. I took some measurements of its rate of progress:

Feb. 26, from 2.15 P. M. to 8.45 P. M. it had traveled  $1\frac{1}{4}$  inches.

Feb. 27, at 9 P. M. the distance covered was  $6\frac{1}{2}$  inches.

Feb. 28, at 9 P. M.  $10\frac{1}{2}$  inches.

March 1, at 9 P. M.  $15\frac{1}{2}$  inches.

So that you will observe the rate of progress is not uniform, but the average rate of progress was 5-26ths inch per hour. A curious circumstance is that while the plant life disappears in all parts of the

glass over which the myxomycete moves, it does not seem to interfere with the animal life on the glass. There are a large number of the brown *Hydra* and numerous small worms, which do not appear to be affected in any way, although they are surrounded by the plasmodium of the myxomycete.

I have not been able to definitely name the species, owing to the absence of the sporngium, but from figures I have seen it resembles *Didymium serpula*. Of course in the foregoing there is nothing very new, but having been fortunate enough to get so fine an example, so favorably located for examination, I thought it might interest some of the members to see under the microscope, an object about which so many diverse views have been held by botanists and zoologists. Apparently the only reason for the botanical claim to it is the fact that in its reproductive stage it forms sporangia like some of the fungi, while on the other hand, from its first appearance in the water or in damp places it acts precisely like an animal in its mode of progress and its way of taking in and digesting solid foods.

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### EDITORIAL.

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**The American Society of Microscopists.**—Our readers will be much amused with the article in this issue written by Dr. James of St. Louis, but we hope that those who are members will resolve to rid the society of such incubuses as now weigh it down, and decide to renovate it. That something is radically wrong, no observing person can fail to see. Dr. James hints that it is run by and for the glorification of one person. We should be sorry to believe such to be the case and are very sorry that others are forced to such a belief. But unfortunately many things give color to this idea. Selfish interests often dominate societies during their decline, while patriotic devotion would produce opposite results. There are unselfish men like

Gage, James, Kellicott, Claypole, Doubleday, Moore, Milnor, Mellor, Shanks, Ward and Whelpley, who might come to the front determined to redeem the society from the odors that have pervaded it of late; and when they do so, a considerable number of men ought to feel interested to attend. We strongly urge upon them this duty to the organization. Apart from the personnel, a radical blunder has been in progress now for years. We refer to the illogical attitude occupied by the society. Formally there was a good microscopical section of the American Association for the Advancement of Science. Certain people who thought it grander to be officers of a national society than of a section of one, withdrew and formed the A. S. M. They chose to cut loose from the parent society and yet they go following the parent around all over the country and parasite upon it. As fast as the personal ambitions of such men have been gratified, they loose interest in the society and neglect to attend. Some who attend do so in pursuit of office and selfish power. The society is cursed by their presence and afterward is supposed to suffer from their absence.

As a section of the American Association it offered less glory for office-seekers, but sufficient opportunity for scholars to read and hear papers. No dues or fees were required except the Association fees. Now, those who belong to both pay double fees and get no more for it.

In order to prevent the prompt publication of papers, a rule is adopted forbidding those who read papers from giving them out to periodicals. Then those papers slumber for months in the Secretary's coat pocket, only to be issued when stale to about 200 people who never read them; and the unoccupied space in the "Proceedings" is eked out with matter utterly foreign to such a publication.

At the present writing, we have, in this JOURNAL, given the public, including almost every country on the globe, a full account of everything of any value connected with the 1894 meeting and have put before 2,000 readers, all that the various authors (whose papers were filed but not read) cared to communicate. In the course of three or four months, that aforesaid coat pocket will be searched and perhaps a mouse will come forth.

The American Society of Microscopists has been sadly in de-

cline for three years past. Gentlemen, we beseech you turn your thoughts towards its interests, or you must prepare crape.

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### MICROSCOPICAL SOCIETIES.

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What Dr. James thought of the Brooklyn meeting of the American Microscopical Society.—Did you ever leave business requiring your personal presence, leave comfortable, and cool offices and apartments, and travel a thousand miles in crowded, stuffy cars in the very height of the dogdays, actuated by a sense of duty and a desire to meet old friends, and in their companionship to undertake congenial scientific studies and investigations—did you ever do this and arrive at your destination soiled and dirty, tired and fagged out, but buoyed up with anticipation of the treat to come, and then repair to the tristing place only to find most of the friends whom you longed to see, absent, no arrangements, or very imperfect ones, made for the reunion that you were to attend, and everything at odds and ends? If you have, you know how I felt on arriving.

The 15th annual meeting of the American Microscopical Society, was in most respects a complete failure, redeemed only by efforts of a few of the faithful whose ardor neither summer's heat, the discomforts of railroad travel and hotel life, nor even "hard times" can allay. At whose door the failure lies, I will not attempt to discuss. It cannot rightfully be attributed to any person or any particular circumstance, but rather to a concatenation of circumstances, all tending to the one end.

Owing to the lack of notice through the usual channels, the pharmaceutical, medical and microscopical journals, few were aware that the meeting would commence on Monday morning (instead of Tuesday, as has been the invariable custom hitherto) and consequently when the hour for opening came, there was only a handful, scarcely a corporal's guard, of members present. These found that absolutely no preparations for the meeting had been made. In the general arrangements for the meeting of the American Association for the Advancement of Science, a place for the members had been allotted, it is true, but no place was provided for the display of new optical instruments



and apparatus (one of the most interesting and important features of the annual meetings), no place or arrangements for the "working sessions," of whose interest and value it is superfluous to speak, not the slightest for the annual conversazione and exhibition, a feature hitherto the pride of the Association and the delight of thousands of citizens of other cities in which the society had held its meetings. There were no badges, and not even a programme had been provided. To cap the climax, the president had not shown up! Is it any wonder that the little handful of the faithful huddled lonesomely in the large and handsome hall of the Polytechnic Institute, dispirited and disappointed?

An informal talk was held, and it was decided to postpone the opening session until the afternoon, and the party adjourned to the headquarters, St. George's Hotel, where, in the constantly increasing number of arrivals of those intending to take part in the meeting of the the Association for the Advancement of Science, they met friends with whom they managed to while away the time until 2 p. m.

At this hour, the president not having arrived, Dr. Hyatt, of Brooklyn, was installed as president, *pro tempore*, and called the meeting to order. Little was done at the session save to map out an order of proceedings, in lieu of a programme. Owing to the fewness of those present it was decided not to read any of the papers except by title. Dr. Seaman, the Secretary, gave a brief sketch of the publications of the society, and of their disposition, and, after routine business, adjournment was had until Tuesday morning.

On Tuesday things looked much brighter. A number of the older members had arrived, and among them the President, Dr. Lester Curtis, and when the hour for meeting arrived some thirty members were in their seats—not a very large number, it is true, but one which redeemed the meeting from utter and abject failure. The morning was passed in hearing committee reports, the appointment of committees, etc., and one or two papers were read. The afternoon of the second day of the annual meeting has hitherto been devoted to the Working Session, but, as stated, as no preparations had been made for this, it was determined to devote it to a visit to the Hoagland Laboratory, and the examination of the bacteriolog-

ical methods, apparatus etc., there employed. This visit was made in acceptance of a very cordial invitation extended by the officers in charge of the laboratory.

I hope I make no breach of confidence in stating that a few of the members concluded to avail themselves of the opportunity to visit Buffalo Bill's "Wild West Show," which was in full blast somewhere in the neighborhood—that is to say, somewhere on Long Island, Manhattan Island, or in New Jersey—elevated railroads, swift ferries, and other agents of rapid transit making any and everywhere within a radius of twenty-five miles of New York "in the neighborhood." Candor also compels me to say that some were seen disporting themselves at Manhattan, Brighton and Coney Island beaches. I have not yet compared the notes of the various delegations, and cannot say which place offered the greatest attractions. I have the word of President Simon P. Gage of Cornell, however, for the statement that Buffalo Bill's show is "bully;" while Dr. W. J. Lewis and the venerable Mr. Lomb, of the celebrated Bausch & Lomb Optical Works at Rochester, assure me that the dark Ulmer beer of the Court Palace (also in the neighborhood of New York) is particularly to be recommended to dyspeptics, and others—a fact that I shall remember with gratitude if a cruel and malignant fate ever causes my wandering feet to stray into the jungles of Brooklyn again (unless when *en route* to Manhattan Beach).

Professors Kellicott, Detmers, Burrill, and a host of those who formerly never failed a meeting, were absent at this one, and there seems to be a general apathy in regard to the society which shows that the new officers must infuse a deal of new life into their work if they would keep the society from going into the dry-rot.

Professor Gage, the new President, is a man in the prime of life and robust health. The Vice-presidents are also energetic men, and they must infuse some of the spirit apparent in their other work into the management of the society. The whims and ideas of one man should not be allowed to be the policy of the association. We will, however, have more to say on this point hereafter.—*National Druggist*.

**Vaccination** is much more effective if practiced at once after recovery from typhoid fever, but no one knows why this is so,

**Brooklyn Institute, Brooklyn, N. Y.**

*January* 14, 1895.—The eighth annual exhibition of the Department of Microscopy of the Brooklyn Institute of Arts and Sciences was held in Art Association Hall. The exhibition was one of the most successful ever held under the auspices of the Institute. Eighty-six microscopes were used, the visitors passing from instrument to instrument. The present officers of the department are: H. F. Calef, president; H. S. Woodman, vice-president; A. H. Ehrman, secretary; C. P. Abbey, treasurer; James Walker, curator.

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**MICROSCOPICAL APPARATUS.**

**A Diagnostic Microscope.**—An instrument has been made by Mr. Charles Baker, of High Holborn, London, at the suggestion of Surgeon Major R. Ross, of the Army Medical Department, for diagnosing cases of malaria fever, etc. It has a sliding tube coarse adjustment, and micrometer screw fine adjustment, square stage of sufficient size to allow any portion of a seven-eighth inch cover-glass mounted on a 3 by 1 inch slip to be examined. It is fitted with a substage condenser, one-twelfth oil immersion objective, and eye-piece, the combination giving a magnification of 700 diameters. The body can be used at a length of 160 m.m., but closes to 100 m.m. to facilitate packing. The instrument is fitted in a solid leather case, six inches by three inches, with shoulder strap and loops to fit to military belt. A few glass slips and cover-glasses, also a bottle of cedar oil and a bleeding needle are packed in the case.—*Pharmaceutical Journal*.

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**MICROSCOPICAL MANIPULATION.**

**To Demonstrate The Layers of Human Skin.**—The human skin is composed of four layers as follows, commencing with the superficial layer:

1 Stratum corneum. 2 Stratum lucidum. 3 Granular layer. 4 Rete mulpighii or rete mucosum.

All of these are easily demonstrated by the usual methods, except the stratum lucidum. This very transparent layer refuses all ordinary stains and is consequently difficult to differ-

entiate. Professor Haag, in the laboratory of Toledo Medical College, demonstrates this layer beautifully by the use of sulpho-indiginate of sodium in the following manner:

The skin is hardened in alcohol in the usual manner, cut and stained preferably in Woodward's Carmine for the reason that sections can be transferred directly from alcohol to the staining fluid without first being hydrated. After being stained, bleached and washed in alcohol until all trace of the acid used in the bleaching fluid is removed they are placed in alcohol, to which a sufficient quantity of a saturated aqueous solution of sulpho-indiginate of sodium is added to give it a sky blue color, in which they are left until the blue color is taken up. If the alcohol has not been tinged too blue, no hurry need be exercised, as the sections are dehydrating at the same time they are staining.

They are then cleaned in oil of cloves and mounted in balsam, in the usual way. Upon examination, stratum lucidum will be seen of a beautiful blue color and clearly defined, while the heavy epithelial cells of the corneum will also be distinctly mapped out.

A little caution is necessary, for if too much of the sulpho-indiginate of sodium solution be added to the alcohol, other portions of the tissue will give up the carmine and take up the blue stain. The stratum lucidum, having the greater affinity for the soda, will take it first and quickly, and if more of it be present than will satisfy its wants, other parts of the tissue will take it up and somewhat mar the differentiation and spoil the beautiful appearance of the specimen.—*American Medical Compend.*

### Constructing an Aquarium for Use with High Powers.—

M. Schandlun has just published in the *Zeitschrift für wissenschaftliche Mikroskopie* an interesting article entitled: Ein Mikroaquarium welches auch zur Paraffin Einbettung für kleine Objecte benutzt werden Kann.

What is especially to be remembered in that communication is the method used by the author in constructing an aquarium which can be used to examine microscopical objects under a tolerably high power.

A rectangle or a square is cut in a slide (near one of the edges.) Then upon the two faces a lamel of glass larger than the

part cut away is fastened. Warm Canada balsam is the best thing to use to stick the lamels to the glass. By this mean a slide is obtained with a cavity in it which cavity can be filled up with the liquid to be examined. This liquid will not run out in consequence of the capillarity, then it will be very easy to place horizontally the aquarium slide under the microscope.

It will be naturally advantageous to fasten at the two ends of the slide and on each of the faces some little strips of glass which will protect the aquarium.

One of the greatest advantages which small similar apparatuses present is this: Once the organisms are placed upon the cover glass it is easy to fix them. Balsam can be dissolved in xylol and the cover glass be used for a preparation.

These apparatuses are to be found in the stores and are sold by Klonne and Muller from Berlin.—*Translated from the "Societe Belge de Microscopie," by Rene Samson.*

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### MEDICAL MICROSCOPY.

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**A Physician's Outfit.**—The present day tendency of medical practice is, very markedly, to rely on microscopical methods of diagnosis. Not only is a microscope essential, as an educational instrument, to every student of medicine, it is also hardly to be dispensed with in the course of any single day's work by any intelligent and capable practitioner. Every state of disease is expressed and characterized by some micro-organic change. And the number of such affections that may be discovered by microscopical examination of the secretions is great, and continually increasing. When, indeed, any conscientious physician is found to be without the aid of this invaluable diagnostic means, that state of things may safely be attributed to poverty and not intention. We deduce the suggestion that a "hire purchase" system, for the acquisition of microscopes by the poorer members of the medical profession, could be worked out to some advantage.

A cheap microscope is of little value to the physician, but, on the other hand, one must not forget that the course of medical education is, in itself, an expensive introduction to the business of life. It is, therefore, not seldom that the young doctor finds himself quite unable to buy a powerful and reliable mi-

croscope, when first that instrumental aid is needed to correct his errors in diagnosis, and save patient's lives. Good service might be done, in some cases, to those who "suffer many things," of the physicians, if a small microscopical laboratory were established by the local instrument maker, for the use of neighboring practitioners, at fixed rates. Several objections however, will at once occur to our readers as likely to deter microscopeless doctors from making such use of the facilities that could thus be offered. More benefits to suffering humanity are to be expected from the advent of those "lay helpers" to qualified physicians, who are now seriously working at the outskirts of medical science with the microscope.—*The Optician, London.*

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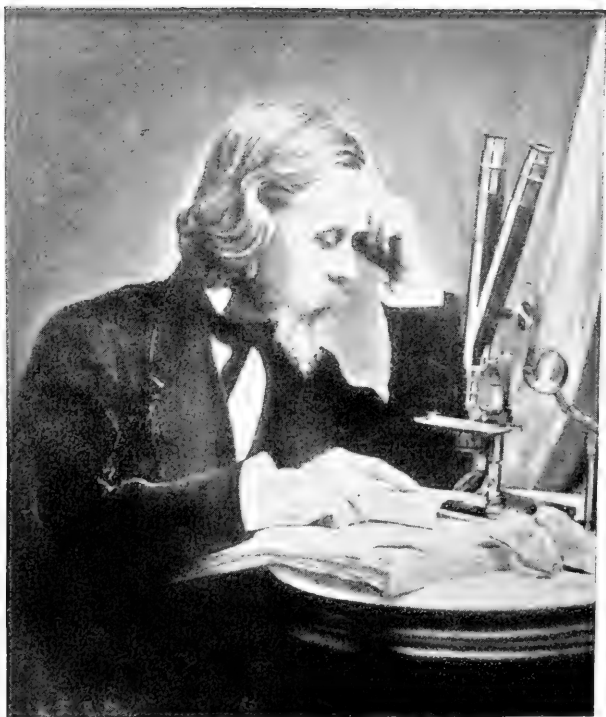
*The Life and Writings of Rafinesque.* By Richard Ellsworth Call, M. D. 4° pp. 227. Price \$2.50. Louisville, Ky., 1895.

This memoir of an early American naturalist has been published by the Filson Club and constitutes No. 10 of a series devoted to Kentucky men. The book is issued in elegant style with wide margins, heavy paper, etc. It may be questionable whether so much expense was warranted by the life of this eccentric fellow. Still there are in it many very curious things and a few contributions to scientific knowledge. Mr. Call has certainly shown an intense enthusiasm for and admiration of his subject, and the Filson Club might have put its money to many worse uses.

Mr. Call is impartial and has not hesitated to picture his hero in the true though often undesirable colors. Much of the book contains curious biography which is of very little scientific value. The patent schemes and quack remedies of Rafinesque seem to have marred seriously his later life. Some of his literary productions are pronounced absolutely without merit. As an expose of literary piracy on the part of those who thought they could profit from Rafinesque's knowledge, the book is very interesting.

As showing incidentally why scientific men commanded very little respect eighty years ago, the book is admirable. As an illustration of self-sacrifice and devotion to science, the early life of Rafinesque was grand.





REV. SAMUEL LOCKWOOD, PH. D.  
LATE PRESIDENT OF THE POSTAL MICROSCOPICAL CLUB.



# THE AMERICAN

## MONTHLY

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### An Artificial Key to Lichens.

By L. A. WILLSON,

CLEVELAND, OHIO.

The object of the following key is to enable a microscopist to determine the genus of any lichen from any of the various spores that pertain to the plant. To see the spores or the tissues, it is not necessary to make sections. Remove an apothecium, soak it in water, then remove the specimen to a slide, cover it with a drop or two of potassium hydrate, macerate, spread it out thin, add a drop of fresh water, cover and examine with a quarter-inch objective. It is a beautiful study. The numbers attached to the genera are those of Tuckerman's Synopsis of Lichens.

No naturalist and especially no microscopist should fail to have some knowledge of every department of nature. It is humiliating to a naturalist when at a picnic or field meeting, to be asked about lichens and to be unable to respond.

### KEY

- |                           |                |
|---------------------------|----------------|
| 1 Sp. granulose           | 13 Umbilicaria |
| 2 Sp. cylindraceous, long | 34 Conotrema   |
| 3 Sp. eight locular       | 64 Normandina  |
| 4 Sp. cymbiform           | 68 Sagedia     |
| 5 Sp. dactyloid A         |                |
| 6 Sp. simple B            |                |
| 7 Sp. spherical C         |                |

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NOTE.—Owing to the frequency of occurrence of these words, Apothecia will be abbreviated to Apo., thalus to th., and spore to sp.—EDITOR.

- 8 Sp. 2 to 4 plurilocular or multilocular D
- 9 Sp. bi-locular D b
- 10 Sp. polar bi-locular E
- 11 Sp. fusiform F
- 12 Sp. acicular G
- 13 Sp. muriform H
- 14 Sp. oblong I
- 15 Sp. ovoid K
- 16 Sp. ellipsoid x
- x Sp. ellipsoid—simple. See under B
- x Not simple L

## A

Spores dactyloid.

- 1 Sp. colorless 48 Lecanactis
- 1 Sp. brown or decolorate 51 Opegrapha

## B

Spores simple.

- 2 Sp. violet, black, spherical 58 Sphaerophorus
- 2 Sp. ovoid y
- y Apo. scutellaeform 1
- 1 Th. frondose, villous beneath clothed with a pannose hypothallus 17 Erioderma
- 1 Th. monophylous, or multifid, squamulose or crustaceous 22 Pannaria
- 1 Th. foliaceous, very rarely fruticulose, gonimia almost always concatenate 27 Collema
- 1 Th. foliaceous, lead colored 28 Leptogium
- y Apothecia orbicular 20 Heppia
- y Apo. depressed-globose urceolate, at length opened 25 Pyrenopsis
- y Apo. rounded or oblong, flat 50 Melaspilea
- y Apo. mostly cephaloid, variously colored, not black 41 Cladonia
- y Apo. immersed in the thallus 63 Endocarpon
- y Apo. innate 69 Verrucaria
- y Apo. depressed-globose thallus epiphyllous, passing into a lobulate crust 72 Strigula
- 2 Sp. ellipsoid or sub ellipsoid, colored a
- 2 Sp. ellipsoid or sub-ellipsoid, colorless b
- a Sp. fuscant 22 Pannaria
- a Sp. brown 1
- 1 Apothecia scutellaeform, black gyrose—plicate 13 Umbilicaria
- 1 Apo. rounded, oblong, black 50 Melaspilea
- 1 Apo. crateriform, stipitate, thallus crustaceous 61 Calicium
- 1 Apo. turbinate with an ostiole 71 Pyrenastrum
- b Th. of jointed filaments 42 Cœnogonium
- b Th. evernieform 10 Parmelia
- b Th. fruticulose 1
- 1 Disk colored differently from the thallus 3
- 1 Disk and thallus pale 4
- 1 Th. brownish black 24 Lichina
- 1 Th. attached to substrate by a single point 26 Omphalaria
- 1 Th. orange 30 Placodium
- 1 Th. yellowish or flesh colored 31 Lecanora
- 1 Th. with podetia 40 Pilophorus
- 1 Th. composed of jointed filaments 43 Cœnogonium
- 3 Apothecia attached to the tips or margin of the thallus 3 Cetraria
- 3 Disk concave, apo. often cyathiform 4 Evernia
- 3 Thallus rounded cottony within, alike on all sides 6 Alecatoria

- b Th. fruticulose, disk and thalus pale,—*Continued*.  
 4 Th. compressed or sub-folliaceous, cartilaginous 2 Ramalina  
 4 Th. rounded, alike on all sides with a double medulla, the  
 inner-most woody 5 Usnea
- b Th. alectoriaeform 1  
 1 Apothecia scutellaeform 10 Parmelia  
 1 Apo. angulate-patellaeform passing into lirellaeform  
 52 Xylographa
- b Th. caulescent 1  
 1 Apo. patellaeform and cephaloid 46 Lecidea  
 1 Apo. unknown, thallus attached to substrate by root-like  
 branches, th. densely cottony within Siphula
- b Th. crustaceous 1  
 1 Apo. scutellaeform 31 Lecanora  
 1 Apo. globular, difform opening by pores, sp. large 33 Pertusaria  
 1 Apo. patellaeform 2  
 2 Thallus squamulose, lobulate granulose; earth and rock  
 lichen reduced and disappearing; sp. minute and very num-  
 erous 44 or 48 Biatora  
 2 Th. uniform, spores various 45 or 49 Heterothecium  
 2 Th. often caulescent apo. horny, th. lobulate, or filiform  
 46 or 50 Lecidea  
 2 Th. lobulate, or uniform 47 or 51 Buellia
- b Th. depressed 1  
 1 Disk and thallus pale 2 Ramalina  
 1 Disk colored differently from the th. to the tips or margins of  
 which the apo. are attached 3 Cetraria
- b Th. foliaceous 1  
 1 Thallus rather membranous 10 Parmelia  
 1 Th. peltate, hypothallus deficient, apo. indicated mostly by  
 an ostiole, but emerging scutellaeform 19 Endocarpaceum  
 1 Th. clothed beneath with a nap-like hypothallus 21 Physma  
 1 Th. attached to the substrate by a single point, apo. subglo-  
 bose 26 Omphalaria  
 1 Apothecia blackened, gyrose plicate 13 Umbilicaria  
 1 Thallus mostly dark green, gonimia mostly concatenate  
 27 Collema  
 1 Th. mostly lead-colored, cortical layer distinctly parenchy-  
 matous 28 Leptogium
- b Th. frondose 1  
 1 Apothecia scutellaeform, marginal 17 Erioderma  
 1 Apo. orbicular, innate 18 Solorina
- b Th. granulose 1  
 1 Apo. sub-globose, immersed or superficial and explicate  
 25 Pyrenopsis  
 1 Apo. patellaeform or cephaloid 44 Biatora  
 1 Apo. cephaloid, solid, black with podetia 40 Pilophorous
- b Th. lobulate 1  
 1 Apo. scutellaeform Omphalodium  
 1 Apo. becoming zeorine 31 Lecanora  
 1 Apo. stipitate 43 Baeomyces  
 1 Apo. sessile a  
 a the exciple paler than the disk 44 Biatora  
 a the exciple coal black 46 Lecidea  
 a the exciple coal black 47 Buellia  
 1 Apo. immersed in thalline warts c  
 c Paraphyses distinct 65 Segestria  
 c Paraphyses obsolete 66 Staurothele

- b Th. monophyllous 1  
 1 Apo. scutellæform Omphalodium  
 1 Apo. subcutellæform, blackened gyrose plicate 13 Umbilicaria  
 1 Apo. immersed in the thallus 63 Endocarpon
- b Th. multifid 1  
 1 Apo. scutellæform 22 Pannaria
- b Th. obscure 1  
 1 Apo. rounded or oblong a  
 a black 57 Mycoporum  
 a softish, reddish, immarginate Agyrum  
 a crateriform, exciple black 61 Calicium  
 a globose colored, exciple obscure 62 Coniocybe  
 1 Apo. immersed in a stroma 67 Trypethelium  
 1 Apo. innate--superficial 68 Sagedia  
 1 Apo. turbinate 71 Pyrenastrum
- b Th. obsolete 1  
 1 Apo. lirellæform, rather prominent 51 Opegrapha  
 1 Apo. rounded, or oblong softish, reddish, emarginate 61 Calicium  
 1 Apo. crateriform stipitate 62 Coniocybe  
 1 Apo. globose stipitate 68 Sagedia  
 1 Apo. innate, superficial 68 Sagedia
- b Th. filiform 1  
 1 Apo. scutellæform, disk thin 10 Parmelia
- b Th. pendulous 1  
 1 Disk and thallus pale 5 Usnea  
 1 Disk colored differently from the thallus a  
 a Disk concave, apothecia, cyathiform 4 Evernia  
 a Th. mostly rounded alike on all sides 6 Alectoria
- b Th. uniform 1  
 1 Apothecia globular, difform 33 Pertusaria  
 1 Apo. patellæform or cephaloid stipitate, stipe disappearing 43 Baeomyces  
 1 Apo. patellæform or cephaloid sessile, exciple paler than the disk 44 Biatora  
 1 Apo. same as the last but exciple often thickened and lecan-  
 oroid 45 Heterothecium  
 1 Apo. sessile, horny exciple coal black 46 Lecidea  
 1 Apo. same as last but not horny 47 Buellia  
 1 Apo. solitary immersed in thalline warts, perithecium colored 65 Segestria  
 1 Apo. innate, perithecium black 69 Verrucaria
- b Th. stellate 1  
 1 Apo. scutellæform Omphalodium
- b Th. tartareous 1  
 1 Apo. patellæform, or cephaloid 44 Biatora  
 1 Apo. patellæform, the exciple often thickened and lecan-  
 oroid 45 Heterothecium  
 1 Apo. patellæform, or cephaloid, thallus lobulate, caulescent,  
 or uniform 46 Lecidea  
 1 Apo. innate, perithecium black, amphothecium pale 69 Verrucaria

## C

Spores simple spherical.

- 1 Apo. indicated only for the most part by an ostiole, but emerging  
 and scutellæform 19 Endocarpium  
 1 Apo. globose, spores violet, black 58 Sphaerophorus

Spores simple, spherical,—*Continued.*

1	Apo. crateriform, sessile	60	Acolium
1	Apo. crateriform stipitate	61	Calicium
1	Apo. globose stipitate	62	Coniocybe

## D

Spores 2-4 locular, pluri-locular, or multilocular.

1	Spores bi-locular, brown a		
1	Spores bi-locular, colorless b		
1	Spores pluri-locular c		
a	Apo. scutellaeform f		
f	Thallus foliaceous or everniaeform	11	Physcia
f	Thallus crustaceous, foliaceous	12	Pyxine
a	Apothecia orbicular	18	Solorina
a	Apo. rounded g		
g	Spores ovoid ellipsoid	50	Melaspilea
g	Spores oblong-ovoid, oblong or fusiform	56	Arthonia
a	Apothecia crateriform h		
h	Thallus fruticulose	59	Acroscyphus
h	Th. crustaceous i		
i	Apothecia sessile	60	Acolium
i	Apo. stipitate	61	Calicium
a	Apo. zeorine or biatorine, spores ellipsoid		
b	Apo. scutellaeform j		
j	Th. fruticulose or pendulous, spores ellipsoid or oblong	2	Ramalina
j	Th. terete compressed dichotomously much branched, spores oblong	8	Speerschneidera
b	Apothecia globular	35	Pertusaria
b	Apo. depressed globose urceolate and opening, thallus granu- lose, spores ellipsoid	25	Pyrenopsis
b	Apo. zeorine or biatorine thallus lobulate or fruticulose often yellow	30	Placidium
b	Apo. rounded or oblong k		
k	Apo. black, spores ovoid-ellipsoid	50	Melaspilea
k	Spores oblong-ovoid or oblong or fusiform	56	Arthonia
c	Spores colored l		
c	Spores colorless or decolorate m		
l	Spores fusiform or acicular 1		
1	Apothecia scutellaeform	14	Sticta
1	Apothecia reniform, innate	15	Nephroma
1	Apothecia rounded or oblong	56	Arthonia
l	Spores ellipsoid 2		
2	Apothecia in warts	66	Staurothele
2	Apothecia zeorine or biatorine	32	Rinodina
l	Spores ovoid-ellipsoid 3		
3	Apothecia urceolate scutellaeform	36	Urceolaria
3	Apothecia immersed in the thallus	63	Endocarpon
l	Spores oblong ovoid 4		
4	Apothecia scutellaeform	22	Pannaria
4	Apothecia rounded, oblong, black	57	Mycoporum
l	Spores oblong 4-locular blackish brown	7	Schizopelte
l	Spores oblong-ellipsoid a		
a	Apothecia from scutellaeform becoming black all over and lecidoid	12	Pyxine
a	Apothecia urceolate, verrucaeform or endocarpine, becom- ing scutellate	37	Thelotrema

- 1 Spores pluri-locular, colored,—*continued*.
- 1 Spores oblong-ellipsoid a
- a Apothecia pattellæform 45 Heterothecium
- a Apothecia prominent 1
- 1 Thallus obscure 70 Pyrenula
- 1 Thallus turbinate opening with an ostiole 71 Pyrenastrum
- a Apothecia rounded or oblong 2
- 2 Bordered by a thalline margin 55 Glyphis
- 2 Black 57 Mycoporium
- a Apothecia crateriform 61 Calicium
- a Apo. immersed 3
- 3 In the thallus 63 Endocarpon
- 3 In a stroma 67 Trypethelium
- 1 Spores muriform, multi-locular a
- a Apothecia scutellæform 4
- 4 Blackened gyrose plicate, spores subellipsoid 13 Umbelicaria
- 4 Spores ovoid-oblong 22 Pannaria
- a Apothecia rounded or oblong 5
- 5 Not black 56 Arthonia
- 5 Black 57 Mycoporium
- a Apothecia patellæform 45 Heterothecium
- a Apo. crateriform or urn-shaped sessile 60 Acolium
- a Apo. urceolate 6
- 6 Spores ovoid-ellipsoid 36 Urceolaria
- 6 Sp. ellipsoid and oblong 37 Thelotrema
- a Apothecia immersed 7
- 7 In the thallus 63 Endocarpon
- 7 In thalline warts 66 Staurothele
- 7 In a stroma 67 Trypethelium
- a Apothecia prominent 8
- 8 Turbinate 71 Pyrenastrum
- 8 Not tubinate 70 Pyrenula
- 1 c Spores colorless or decolorate m
- m Apothecia reniform 15 Nephroma
- m Apo. explanate 38 Gyrostomum
- m Apo. orbicular 38 Gyrostomum
- m Apo. scutellæform a
- a Disk black with a white bloom, thallus fruticulose or pendulous 1 Roccella
- a Thallus terete, compressed dichotomously branched and intertangled 8 Speerschnneidera
- a Disk yellowish orange, thallus mostly foliaceous, ascendant, avernæform 9 Theloschistes
- a Th. frondose-foliaceous, coriaceous-cartilagenous, underside with cyphels or spots 14 Sticta
- a Th. monophylous or multifid, squamulose or crustaceous 22 Pannaria
- a Th. foliaceous or fruticulose, mostly dark green, gonimia concatenate 27 Collema
- a Th. foliaceous or fruticulose, mostly lead color 28 Leptogium
- m Apothecia peltæform b
- b Thallus frondose, villous beneath 16 Peltigera
- b Th. lobulate, squamulose, or crustaceous uniform 44 Biatora
- b Th. crustaceous, uniform, granulose and tartareous, spores generally large, sometimes minute, numerous in the thekes 45 Heterothecium

1 Spores plurilocular, colorless, or decolorate,—*Continued.*

- m Apothecia zeorine c
  - c Thallus monophyllous, multifid, squamulose or crustaceous
    - 22 Pannaria
  - c Th. foliaceous or fruticulose, mostly lead colored, gonimia concatenate
    - 28 Leptogium
- m Apothecia biatorine d
  - d Thallus monophyllous, multifid squamulose or crustaceous
    - 22 Pannaria
  - d Th. foliaceous or fruticulose, mostly lead colored, gonimia concatenate
    - 28 Leptogium
  - d Th. foliaceous, lead colored, gonimia in short chains
    - 29 Hydrothyria
  - d Th. uniform with a crenulate margin ; apothecia urceolate
    - 35 Gyalecta
- m Apothecia urceolate e
  - e Spores cylindraceous, very long, plurilocular, colorless, bi-quadri-pluri-locular, uncolored
    - 34 Conotrema
  - e Spores ellipsoid, fusiform or acicular, bi-quadri-pluri-locular, uncolored
    - 35 Gyalecta
  - e Spores ellipsoid and oblong, bi-pluri-locular, muriform, multilocular, brown or decolorate
    - 37 Thelotrema
  - e Spores ellipsoid and oblong, muriform plurilocular, brown
    - 38 Gyrostomum
- m Apothecia rounded f
  - f Each cell containing a single theke
    - Myriangium
  - f Apothecia immersed in a white stroma 1
    - 1 Apo. plano-convex, immarginate
      - 54 Chiodecton
    - 1 Apo. concave, black
      - 55 Glyphis
    - f Apo. in a pseudo-stroma 2
      - 2 Stroma difform, rounded or stellate
        - 56 Arthonia
      - 2 Stroma difform with 1-6 hymenia
        - 57 Mycoporum
  - m Apothecia difform g
    - g Spores ellipsoid, muriform, pluri-locular, brown
      - 38 Gyrostomum
    - g Spores fusiform, or oblong-ovoid, uncolored
      - 54 Chiodecton
  - m Apothecia oblong h
    - h Spores fusiform, oblong-ovoid, uncolored, quadri-plurilocular, muriform multilocular
      - 54 Chiodecton
    - h Spores ellipsoid, oblong brown or decolorate, quadri-plurilocular
      - 55 Glyphis
    - h Spores oblong-ovoid or fusiform, brown or decolorate 2-4 plurilocular or muriform multilocular
      - 56 Arthonia
  - m Apothecia immersed in the thallus i
    - i Spores uncolored
      - 65 Segrestria
    - i Spores brown or decolorate 3
      - 3 Thallus foliaceous, monophyllous or squamulose and sub-crustaceous
        - 63 Endocarpon
      - 3 Thallus lobulate or uniform
        - 66 Staurothele
  - m Apothecia innate superficial j
    - j Spores cymbiform, fusiform acicular, colorless
      - 68 Sagedia
    - j Sp. ovoid-ellipsoid, decolorate or colorless
      - 69 Verrucaria
  - m Apothecia prominent opening only by a pore at the summit k
    - k Apo. depressed, globose, spores oblong or ovoid
      - 72 Strigula
    - k Spores ellipsoid oblong
      - 70 Pyrenula

## E

Spores polar bi-ocular.

- |   |   |    |               |
|---|---|----|---------------|
| 1 | Apothecia scutellaeform, thallus yellowish foliaceous, the disk yellowish orange. | 9  | Theloschistes |
| 1 | Apothecia zeorine or biatorine, thallus fruticulose, uniform and often yellowish  | 30 | Placodium     |

## F

Spores fusiform.

- |   |                  |   |    |              |
|---|------------------|---|----|--------------|
| 1 | Spores brown     | a   |    |              |
|   | a                | Apothecia orbicular, innate                                 | 18 | Solorina     |
|   | a                | Apo. lirellaeform   | 51 | Opegrapha    |
|   | a                | Apo. rounded or oblong                                      | 56 | Arthonia     |
| 1 | Spores fuculent  | b   |    |              |
|   | b                | Apo. scutellaeform  | 14 | Sticta       |
|   | b                | Apo. reniform   | 15 | Nephroma     |
| 1 | Spores colorless | c   |    |              |
|   | c                | Th. pendulous; disk of apothecium black, with a white bloom | 1  | Roccella     |
|   | c                | Th. granulose   | 27 | Collema      |
|   | c                | Th. of jointed filaments                                    | 42 | Coeogonium   |
|   | c                | Th. fruticulose   | 1  | Roccella     |
|   | 1                | Apo. disk black with a white bloom                          | 31 | Lecanora     |
|   | 1                | Apo. zeorine  | 42 | Coeogonium   |
|   | 1                | Thallus of jointed filaments                                | 39 | Stereocaulon |
|   | 1                | Apothecia patellaeform                                      | 46 | Lecidea      |
|   | x                | With podecia  | 46 | Lecidea      |
|   | x                | Without podecia   | 27 | Collema      |
|   | 1                | Thallus caulescent  | 28 | Leptogium    |
|   | 1                | Apothecia scutellaeform                                     | 14 | Sticta       |
|   | y                | Thallus mostly dark green                                   | 16 | Peltigera    |
|   | y                | Th. mostly lead color                                       | 14 | Sticta       |
|   | c                | Th. frondose  | 27 | Collema      |
|   | 2                | The underside with cyphels                                  | 28 | Leptogium    |
|   | 2                | Villous and veiny beneath                                   | 29 | Hydrothyria  |
|   | c                | Thallus foliaceous  | 31 | Lecanora     |
|   | 3                | Coriaceous cartilagenous, the underside with cyphels        | 43 | Baeomyces    |
|   | 3                | Dark green  | 44 | Biatora      |
|   | 3                | Lead colored  | 46 | Lecidea      |
|   | z                | Cortical layer, parenchymatous spores ovoid-ellipsoid       | 51 | Opegrapha    |
|   |                  |   | 56 | Arthonia     |
|   | z                | Cortical layer distinct, spores fusiform quadri-ocular      | 68 | Sagedia      |
|   | c                | Thallus lobulate  | 6  |              |
|   | 4                | Apothecia zeorine   |    |              |
|   | 4                | Apo. patellaeform   |    |              |
|   | p                | Apothecia stipitate   |    |              |
|   | p                | Apo. sessile  |    |              |
|   | q                | Exciple paler than the disk                                 |    |              |
|   | q                | Exciple coal black  |    |              |
|   | c                | Thallus obscure or almost obsolete                          |    |              |
|   | 5                | Apothecia lirellaeform                                      |    |              |
|   | 5                | Apo. rounded or oblong                                      |    |              |
|   | 5                | Apo. innate, superficial                                    |    |              |
|   | c                | Thallus uniform   |    |              |



1 Spores fusiform, colorless.—*Continued.*

c	Thalus uniform	6		
6	Apothecia lirellæform		51	Opegrapha
6	Apo. patellæform	z		
	z Stipitate		43	Bæomyces
	z Sessile		44	Biatora
6	Apothecia rounded, exciple paler than the disk	x		
	x Black		48	Lecanactis
	x Exciple obscure		49	Platygrapha
	x Apothecia immersed in a white stroma		54	Chiodecton
	x Apo. immersed in stellate pseudo-stroma		56	Arthonia
6	Apothecia oblong	p		
	p Exciple obscure		49	Platygrapha
	p Ex. black		51	Opegrapha
	p Apothecia immersed in a white stroma		54	Chiodecton
	p Apo. immersed in a stellate pseudo-stroma		56	Arthonia
6	Apothecia cephaloid	m		
	m Stipitate		43	Bæomyces
	m Sessile		44	Biatora
6	Apothecia difform	n		
	n Exciple black		51	Opegrapha
	n Apothecia immersed in a white stroma		54	Chiodecton
	n Apo. immersed in a stellate pseudo-stroma		56	Arthonia

## G

## Spores acicular.

1	Th. fruticulose		39	Stereocaulon
1	Th. caulescent		46	Lecidia
1	Th. disappearing		68	Sagedia
1	Th. frondose foliaceous	a		
	a Apothecia scutellæform		14	Sticta
	a Apo. peltæform		16	Peltigera
I	Th. uniform	b		
	b Apothecia innate, superficial		68	Sagedia
	b Apo. urceolate, biatorine		35	Gyalecta
	b Apo. patellæform	z		
	z Apo. softish		44	Biatora
	z Apo. horny		46	Lecidia

## H

## Spores muriform.

1	Spores colored	a		
1	Sp. decolorate	b		
	a Spores fuscous		22	Pannaria
	a Sp. scarcely colored	1		
	1 Thallus dark green		27	Collema
	1 Thallus lead colored		28	Leptogium
a	Spores brown	2		
	2 Apothecia disk colored differently from the thallus	6	Alectoria	
	2 Apo. scutellæform	t		
	t Blackened gyrose-plicate		13	Umbilicaria
	t Urceolate scutellæform		36	Urceolaria
	2 Apothecia urceolate	u		
	u Thallus uniform		36	Urceolaria
	u Th. crustaceous, uniform		37	Thelotrema
a	Apothecia lirellæform		53	Graphis
a	Apo. patellæform	3		

1 Spores muriform, colored, Apo. patelliform 3.—*Continued.*

- |   |   |    |               |
|---|---|----|---------------|
| 3 | Exciple paler than the disk   | 45 | Heterothecium |
| 3 | Ex. coal black  | 47 | Buellia       |
| a | Apothecia difform, rounded or oblong 4  |    |               |
| 4 | In a difform rounded or stellate pseudo-stroma  | 56 | Arthonia      |
| 4 | Black in a difform pseudo-stroma  | 57 | Mycoporum     |
| a | Apothecia crateriform   | 60 | Acolium       |
| a | Apo. globular immersed 5  |    |               |
| 5 | In the thallus  | 63 | Endocarpon    |
| 5 | In thalline warts   | 66 | Staurothele   |
| 5 | In a stroma   | 67 | Trypethelium  |
| 5 | Solitary or confluent prominent   | 70 | Pyrenula      |
| 5 | Sol. or confluent turbinate   | 71 | Pyrenastrum   |
| b | Apothecia lirellæform   | 53 | Graphis       |
| b | Apo. urcælate   | 37 | Thelotrema    |
| b | Apo. patellæform 1  |    |               |
| 1 | Exciple paler than the disk   | 45 | Heterothecium |
| 1 | Ex. coal black  | 47 | Buellia       |
| b | Apothecia scutellæform 2  |    |               |
| 2 | Apothecia blackened, gyrose plicate thallus attached to the substrate by a single point | 13 | Umbilicaria   |
| 2 | Thallus crustaceous, squamulose, granulose, parenchymatous                              | 22 | Pannaria      |
| 2 | Thallus dark green  | 27 | Collema       |
| 2 | Th. lead colored  | 28 | Leptogium     |
| b | Apothecia rounded or oblong 3   |    |               |
| 3 | Difform in a white stroma   | 54 | Chiodecton    |
| 3 | In a difform pseudo-stroma  | 57 | Mycoporum     |
| 3 | In a rounded or stellate pseudo-stroma  | 56 | Arthonia      |
| b | Apothecia immersed 4  |    |               |
| 4 | In the thallus  | 63 | Endocarpon    |
| 4 | In thalline warts   | 67 | Trypethelium  |
| 4 | Innate  | 69 | Verrucaria    |
| 4 | Prominent   | 70 | Pyrenula      |

## I

## Spores oblong.

- |   |   |    |               |
|---|---|----|---------------|
| 1 | Oblong only a                                       |    |               |
| 1 | Oblong ovoid b                                      |    |               |
| 1 | Oblong ellipsoid c                                  |    |               |
| 1 | Oblong fusiform d                                   |    |               |
| a | Colored 1   |    |               |
| a | Colorless or decolorate 2                           |    |               |
| a | Fuесcent  | 22 | Pannaria      |
| 1 | Thallus fruticulose                                 | 7  | Schizopelte   |
| 1 | Th. foliaceous squamulose or crustaceous            | 63 | Endocarpon    |
| 1 | Th. uniform z                                       |    |               |
| z | Apothecia patellæform                               | 45 | Heterothecium |
| z | Apo. rounded or oblong x                            |    |               |
| x | Apo. concave black in a white stroma                | 55 | Glyphis       |
| x | Apo. in a difform rounded or stellate pseudo stroma | 56 | Arthonia      |
| x | Apo. black in a difform pseudo-stroma               | 57 | Mycoporum     |
| 1 | Apo. crateriform, stipitate                         | 61 | Calicium      |
| 2 | Colorless or decolorate y                           |    |               |
| y | Thallus squamæform or monophyllous                  | 64 | Normandina    |

- 1 Spores oblong only, colorless or decolorate y—*Continued.*
- y Th. foliaceous x
    - x Apothecia immersed 63 Endocarpon
    - x Apothecia scutellæform z
      - z Spores 2-4 locular 8 Speerschneidera
      - z Sp. simple 10 Parmelia
  - y Thallus uniform x
    - x Apothecia patellæform u
    - x Apo. rounded or oblong z
      - u Spores bi-quadri-locular or fusiform and acicular 44 Biatora
      - u Sp. bi-plurilocular or muriform multilocular 45 Heterothecium
      - z In a difform rounded or stellate pseudo-stroma 56 Arthonia
      - z In a difform pseudo-stroma 57 Mycoporum
  - 1 b Oblong ovoid b
  - b Colorless x
  - b Decolorate y
    - x Thallus fruticulose 7 Shizopelte
    - x Th. rounded, no gonidia Myriangium
    - x Th. squamulose i
      - i Without podetia 22 Pannaria
      - i With podetia 41 Cladonia
    - x Thallus uniform z
      - z In a white stroma 54 Chiodecton
      - z In a stellate pseudo-stroma 56 Arthonia
      - z In a difform pseudo-stroma 57 Mycoporum
      - y In a stellate pseudo stroma 56 Arthonia
      - y In a difform pseudo-stroma 57 Mycoporum
      - y Apothecia turbinate 71 Pyrenastrum
  - 1 c Oblong decolorate
  - c Spores colored x
  - c Sp. colorless y
  - c Sp. decolorate z
    - x Apothecia urceolate 37 Thelotrema
    - x Apo. scutellæform 12 Pyxine
    - x Apo. patellæform 47 Buellia
    - x Apo. lirellæform 53 Graphis
    - x Apo. crateriform 61 Calicium
    - x Apo. rounded, concave 55 Glyphis
    - x Apo. globular, immersed in the thallus i
      - i Thallus foliaceous 63 Endocarpon
      - i Th. uniform, disappearing 67 Trypethelium
      - i Th. obscure q
        - q Apothecia prominent 70 Pyrenula
        - q Apo. turbinate 71 Pyrenastrum
    - y Thallus fruticulose 1
    - y Th foliaceous 2
    - y Th. squamulose 63 Endocarpon
    - y Th. crustaceous w
    - y Th. filiform 23 Ephebe
    - y Th. monophylous 63 Endocarpon
    - y Th. lobulate v
    - y Th. uniform u
    - y Th. obselete or obscure t
      - 1 Disk and thallus pale 2 Ramalina
      - 1 Apothecia zeorine 31 Lecanora
      - 2 Apo. scutellæform becoming black all over and lecidoid 12 Pyxine

- 1 c Oblong decolorate, Spores colorless, Th. foliaceous,—*Continued*.
- x Apo. immersed in the thallus 63 Endocarpon
  - w Apo. from scutellæform becoming black all over and  
  lecidoid 12 Pyxine
  - w Apo. urceolate-scutellæform, spores ellipsoid and oblong,  
  bi-plurilocular or muriform plurilocular 37 Thelotrema
  - v Apo. zeorine or biatorine 31 Lecanora
  - v Apo. globular opening by a pore at the summit, immersed in  
  thalline warts 65 Segestria
  - u Apo. lirellæform 53 Graphis
  - u Apo. rounded, oblong, concave black 55 Glyphis
  - u Apo. immersed in thalline warts 65 Segestria
  - u Apo. immersed in a stroma 67 Trypethelium
  - t Apo. lirellæform 53 Graphis
  - t Apo. globular 70 Pyrenula
  - z Spores decolorate
  - z Apothecia rounded or oblong 56 Arthonia
  - z Apo. rounded oblong black 57 Mycoporum
  - z Apo. turbinate, prominent 71 Pyrenastrum
- 1 d Oblong fusiform
- d Thallus fruticulose 1
    - 1 Apothecia disk black with a white bloom 1 Roccella
    - 1 Apo. zeorine 31 Lecanora
  - d Thallus frondose, villous beneath 18 Solorina
  - d Th. lobulate 2
    - 2 Apothecia zeorine 31 Lecanora
    - 2 Apo. patellæform or cephaloid 44 Biatora
    - 2 Apothecia urceolate 4
  - d Thallus uniform 3
    - 3 Apo. patellæform or cephaloid 44 Biatora
    - 3 Apo. rounded oblong, black 48 Lecanactis
    - 4 Apo. biatorine with a crenulate margin 35 Gyalecta
    - 4 Apo. colored with a torn margin 37 Thelotrema
  - d Thallus crustaceous 37 Thelotrema

## K

Spores ovoid.

- 1 Colored a
- 1 Colorless b
- a Apothecia urceolate-scutellæform 36 Urceolaria
  - a Apo. immersed in the thallus 63 Endocarpon
  - a Apo. rounded oblong 1
    - 1 Black 50 Melaspilea
    - 1 Black difform 57 Mycoporum
    - 1 Difform 56 Arthonia
  - b Apothecia orbicular 20 Heppia
  - b Apothecia rounded or oblong 1
    - 1 Not black 56 Arthonia
    - 1 Black 2
      - 2 Apothecia difform with a margin 50 Melaspilea
      - 2 Apo. difform without a margin 57 Mycoporum
  - b Apothecia lecanoroid Myriangium
  - b Apo. depressed urceolate, globose 25 Pyrenopsis
  - b Apo. cephaloid 41 Cladonia
  - b Apo. scutellæform 2
    - 2 Thallus frondose villous beneath 17 Erioderma
    - 2 Th. monophyllous or multifid squamulose or crustaceous 10 Parmelia

- 1 Spores ovoid, colorless, apo. scutelliform.—*Continued.*  
 2 Th. foliaceous or fruticulose dark green 27 Collema  
 2 Th. foliaceous or fruticulose lead colored 28 Leptogium  
 b Apothecia globular 3  
 3 Immersed in the thallus 63 Endocarpon  
 3 Apothecia innate 69 Verrucaria  
 3 Globose, prominent depressed 72 Strigula

## L

Spores ellipsoid, not simple.

- 1 2-locular a  
 1 Muriform multilocular b  
 1 Quadrilocular c  
 1 Bi-quadrilocular d  
 1 Bi-plurilocular e  
 a Colorless 1  
 a Brown 2  
 1 Thallus granulose 25 Pyrenopsis  
 1 Thallus fruticulose x  
 x Thallus leathery, disk and thallus pale 2 Ramalina  
 x Th. dark green 27 Collema  
 x Th. lead colored 28 Leptogium  
 1 Thallus foliaceous y  
 y Dark green 27 Collema  
 y Lead colored 28 Leptogium  
 1 Thallus uniform z  
 z Apothecia patellaeform 45 Heterothecium  
 z Apo. rounded, difform, oblong black 50 Melaspilea  
 2 Thallus foliaceous p  
 2 Th. crustaceous q  
 2 Th. frondose 18 Solorina  
 2 Th. lobulate r  
 2 Thallus uniform s  
 2 Thallus obsolete t  
 p Disk thickish 11 Physcia  
 p Disk not thickish 12 Pyxine  
 q Apothecia scutellaeform, black all over and lecideoid 12 Pyxine  
 q Apo. crateriform, stipitate 61 Calicium  
 q Apo. immersed in thalline warts 66 Staurothele  
 r Apo. zeorine or biatorine 32 Rinodina  
 r Apo. globular immersed in thalline warts 66 Staurothele  
 s Apo. zeorine or biatorine 32 Rinodina  
 s Apo. difform rounded or oblong black 50 Melaspilea  
 s Apo. immersed in a white stroma 54 Chiodecton  
 t Apo. difform rounded or oblong black 50 Melaspilea  
 t Apo. crateriform, stipitate 61 Calicium  
 b Apothecia scutellaeform 1  
 b Apo. patellaeform 2  
 b Apo. crateriform 60 Acolium  
 b Apo. urceolate 3  
 b Apo. lecanoroid Myriangium  
 b Apo. lirellaeform 4  
 b Apo immersed 5  
 1 Thallus fruticulose m  
 m Disk colored differently from the thallus 6 Alecatoria  
 m Thallus dark green 27 Collema  
 m Th. lead colored 28 Leptogium  
 1 Th. crustaceous foliaceous 13 Umbilicaria

Sp. ellipsoid, not simple, multiform, etc.,—*Continued.*

- |   |                  |
|---|------------------|
| 1 Th. uniform   | 36 Urceolaria    |
| 1 Th. foliaceous n                                    |                  |
| n Apothecia blackened, gyroseplicate                  | 13 Umbilicaria   |
| n Thallus dark green                                  | 27 Collema       |
| n Thallus lead colored                                | 28 Leptogium     |
| 2 Apothecia sessile, exciple paler than the disk      | 45 Heterothecium |
| 2 Apo. sessile, exciple coal black                    | 47 Buellia       |
| 2 Apo. angulate, exciple softish                      | 52 Xylographa    |
| 3 Exciple with black disk and white margin            | 36 Urceolaria    |
| 3 Ex. with a torn margin                              | 37 Thelotrema    |
| 3 Ex. with an entire margin                           | 38 Gyrostomum    |
| 4 Thallus innate in the matrix                        | 52 Xylographa    |
| 4 Th. uniform or obsolete                             | 53 Graphis       |
| 5 Immersed in the thallus                             | 63 Endocarpon    |
| 5 Im. in a stroma                                     | 67 Trypethelium  |
| 5 Innate  | 69 Verrucaria    |
| 5 Immersed in thalline warts p                        |                  |
| p Paraphyses distinct                                 | 65 Segestria     |
| p Paraphyses obsolete                                 | 66 Staurothele   |
| 5 Apothecia prominent q                               |                  |
| q Turbinate   | 71 Pyrenastrum   |
| q Not turbinate                                       | 70 Pyrenula      |
| c Brown a   |                  |
| c Colorless b   |                  |
| a Apothecia scutellaeform 1                           |                  |
| 1 Thallus crustaceous or evernaeform                  | 11 Physcia       |
| 1 Th. crustaceous foliaceous                          | 12 Pyxine        |
| a Apothecia zeorine or biatorine                      | 32 Rinodina      |
| a Apo. in a stroma 2                                  |                  |
| 2 Concave in a white stroma                           | 55 Glyphis       |
| 2 In a verruaceform stroma                            | 67 Trypethelium  |
| b Apothecia lirelaleform                              | 53 Graphis       |
| b Apo. crateriform 1                                  |                  |
| 1 Urn shaped  | 60 Acolium       |
| 1 Stipitate   | 61 Calicium      |
| b Apothecia in a stroma 2                             |                  |
| 2 In a white stroma rounded or oblong concave         | 55 Glyphis       |
| 2 Immersed, paraphyses distinct                       | 67 Trypethelium  |
| 2 Innate, paraphyses slender, indistinct, or obsolete | 69 Verrucaria    |
| d Brown 1   |                  |
| d Colorless 2   |                  |
| 1 Apothecia patellaeform                              | 47 Buellia       |
| 1 Apo. immersed                                       | 63 Endocarpon    |
| 2 Apo. zeorine  | 31 Lecanora      |
| 2 Apo. biatorine                                      | 35 Gyalecta      |
| 2 Apo. patellaeform m                                 |                  |
| m Stipitate   | 43 Baeomyces     |
| m Sessile, spores colorless                           | 46 Lecidea       |
| m Sessile, spores decolorate                          | 47 Buellia       |
| 2 Apothecia cephaloid n                               |                  |
| n Stipitate   | 43 Baeomyces     |
| n Sessile   | 46 Lecidea       |
| 2 Apothecia immersed o                                |                  |
| o In the thallus                                      | 63 Endocarpon    |
| o In thalline warts                                   | 65 Segestria     |
| e Apothecia urceolate                                 | 37 Thelotrema    |
| e Apo. globular, prominent                            | 70 Pyrenula      |

## Glossary of Terms Used in the Key to Lichens.

Acicular, needle-shaped.

Alectoriaeform, having the form of the genus *Alectoria*.

Amphi, both, two.

Apothecium, the ascigerous fructification of lichens, forming masses of various shapes.

Ascendant, rising towards the zenith.

Aveniform, resembling a grain of oats.

Biatorine, resembling the genus *Biatora*, having a proper exciple which is not coal-black but colored or blackening.

Cartilaginous, firm and tough like cartilage.

Caullescent, having a leafy stem.

Cephaloid, shaped like the head.

Concatenate, linked together.

Coriaceous, leathery, tough.

Cortical, resembling bark.

Crateriform, like a shallow bowl.

Crustaceous, having a crustlike shell.

Cylindraceous, approaching the form of a cylinder.

Cyathiform, cup-shaped.

Cymbiform, shaped like a boat.

Cyphels, cup-like pits or depressions on the under surface of the thallus, usually white or yellow.

Dactyloid, finger-like in form or arrangement.

Decolorate, deprived of color.

Difform, irregular, not uniform.

Dichotomous, regularly dividing by pairs.

Ellipsoid, shaped like an ellipse.

Emarginate, notched at the summit.

Endocarpein, having the apothecia sunken in the substance of the thallus as in the genus *Endocarpon*.

Epiphyllous, growing upon or inserted into a leaf.

Everniaeform, shaped like the genus *Evernia*.

Exciple, the outer part of the fructification of most lichens.

Explanate, spreading or extending outwardly in a flat form.

Explicate, unfolded.

Foliaceous, having the texture or nature of a leaf.

Filiform, having the shape of a thread.

Frondose, resembling a frond.

Fruticulose, full of fruit.

Fusiform, tapering at each end.

Globose, resembling a globe.

Gonidium, a component cell of the yellowish green layer in certain lichens.

Gonimia, bluish-green granules which occur in certain lichens.

Granulose, full of grains.

Gyrose, turned round like a crook or bent to and fro.

Gyroseplicate, turned round like a crook and folded.

Hypothallus, under the thallus.

Hymenium, the spore-bearing surface of certain fungi.

Innate, joined by the base to the very tip of a filament.

Immarginate, not having a distinct margin or border.

Lecanoroid, resembling the genus *Lecanora*.

Lecidioid, resembling the genus *Lecidea*. [the middle.)

Lirelliform, like a lirella or furrow. (A linear apothecium furrowed along

Lobulate, divided into lobes or rounded projections.

Locular, relating to the cells or compartments of an ovary.

Matrix, the lifeless portion of tissue situated between cells. [a plant.

Medulla, a soft, cellular tissue occupying the center of the stem or branch of

Membranaceous, resembling membrane or thin skin.

Monophyllus, one-leaved.

Multifid, having many segments.

Muriform, resembling courses of bricks in a wall.

Orbicular, spherical.

Ostiole, the exterior opening of a stomate, a small orifice.

Ovoid, egg-shaped.

Pannose, similar in texture to felt or woolen cloth.

Paraphyses, minute jointed filaments growing with the spore cases.

Parenchymatous, pertaining to the parenchyma of a tissue. [of leaves.

Parenchyma, a soft, cellular substance of the tissues of plants like the pulp

Patelliform, pan-shaped. [tion.

Perithecium, an organ surrounding and enveloping the masses of fructifica-

Podetia, stalks that bear the fructification.

Reniform, kidney-shaped.

Scutellate, salver-shaped.

Scutelliform, scutellate, dish-shaped.

Sessile, without petiole or foot-stalk, resting directly on the stem.

Squamulose, having little scales.

Stipitate, supported by a stipe or stalk.

Stroma, a couch or bed, a layer or mass of cellular tissue, especially that part of the thallus enclosing the perithecia.

Subglobose, not quite globose.

Tartareous, having the surface rough and crumbling.

Terete, cylindrical and slightly tapering.

Theca, a case or sheath.

Thalline, consisting of thallus.

Thallus, a solid mass of cellular tissue, of one or more layers, usually flat but sometimes erect or pendulous, elongated and branching.

Thecium, that part of the apothecium which contains the organs of the fruit.

Turbinate, shaped like a top or inverted cone.

Urceolate, pitcher-shaped or urn-shaped.

Verruciform, shaped like a wart.

Villous, covered with fine hairs. [thalline exciple.

Zeorine, with an apothecium in which a proper exciple is enclosed in the



## Classification of the Radiolaria: Key to the Species of Barbadoes.

BY REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

*Continued from p. 384, Vol. XV.*

### 34. SPONGOPRUNUM.

Meshes scarcely broader than the bars ; polar spines conical. ....amphilonche.

### 35. SPONGODRUPPA.

Cortical shell thorny, nearly 5 times as broad as medullary shell...pistachia.

### 36. SPONGOTRACTUS.

Cortical shell rough ; polar spines conical, sulcated.....pachystylus.

### 37. SPONGOLIVA.

Cortical shell smooth, 4 times as broad as outer medullary shell.....cerasina.

### 38. SPONGOXIPHUS.

Cortical shell thorny ; medullary shells spherical.....sphaerococcus.

### 39. ARTISCUS.

Pores circular, 10-11 on half equator.....paniculus.

### 40. CYPASSIS.

Outer cortical shell thorny ; inner cortical shell with 10-11 pores on half equator of each chamber.....entomocora.

### 41. CANNARTISCUS.

Cortical shell rough ; pores 10-12 on half-equator of each chamber.....amphicylindrus.

### 42. CANNARTIDIUM.

Cortical shell without fenestrated protuberances ; pores 10-12 on half equator of each chamber.....amphicanna.

### 43. PANARTUS.

Cortical shell smooth ; pores 8-15 on half-equator of each chamber. ....tetraphalangus.

### 44. OMMATOCAMPE.

Cortical shell smooth ; every chamber with 3 transverse rows of pores 2-3 times as broad as the bars.....polyarthra.

### 45. SETHODISCUS.

Disk with thorny surface ; pores 11-12 on the radius.....echinatus.

### 46. PHACODISCUS.

Disk smooth ; pores 12-13 on the radius.....lentiformis.

## 47. PERIPHÆNA.

Pores 20-22 on radius of disk; solid girdle nearly as broad as radius of medullary shell .....decora.

## 48. SETHOSTYLUS.

Disk spiny ; 3-4 series of conical marginal spines .....spicatus.

## 49. PHACOSTYLUS.

Disk smooth; solid girdle with 100-120 teeth. ....maximus.

## 50. TRIACTISCUS.

Disk thorny ; pores 8-9 on the radius..... tripodiscus.

## 51. HELIOSESTRUM.

No girdle ; diam. of disk 6 times that of medullary shell. ....solarium.

No girdle ; diam. of disk 4 times that of medullary shell.....contiguum.

Girdle ; diam. of disk 3 times that of medullary shell.... craspedotum.

## 52. HELIODISCUS.

No girdle ; 60-80 marginal spines .....helianthus.

Girdle radially striped ; 16-20 teeth on margin..... humboldti.

Girdle not radially striped ; 10-20 teeth on margin.....umbonatus.

## 53. ASTROPHACUS.

Surface smooth ; girdle radially striped; 18-24 marginal spines. ....cingillum.

## 54. LITHOCYCLIA.

Phacoid shell surrounded by 7-11 chambered rings ; pores 9 on radius of phacoid shell.....ocellus.

Phacoid shell surrounded by 5-8 chambered rings ; pores 7 on radius of phacoid shell.....monococcus.

## 55. STYLOCYCLIA.

Phacoid shell surrounded by 5-8 chambered rings. ....dimidiata.

Phacoid shell surrounded by 4 chambered rings..... excavata.

## 56. AMPHICYCLIA.

Phacoid shell spongy, twice as broad as outer medullary shell...pachydiscus.

## 57. STAUROCYCLIA.

Phacoid shell surrounded by 3-4 spongy rings ; the 4 crossed spines with serrated edges..... serrata.

## 58. ASTROCYCLIA.

Phacoid shell surrounded by 4-8 rings.....stella.

Phacoid shell surrounded by 3 rings.....heterocycla.

## 59. COCCOCYCLIA.

Numerous marginal spines arranged in several circles.....heliantha.

## 60. TRIGONACTURA.

Arms without terminal spine, nearly square.....pythagoræ.  
 Arms without terminal spine, club-shaped.....rhopalastrella.  
 Arms with terminal spine, triangular.....trigonodiscus.  
 Arms with terminal spine, club-shaped.....trixiphos.

## 61. HYMENACTURA.

Arms without terminal spines, nearly trapezoidal.....pythagoræ.  
 Arms without terminal spines, slender, lanceolate.....trigona.  
 Arms without terminal spines, nearly equilateral triangular.....hexagona.  
 Arms with terminal spines, nearly square.....ptolemæi.

## 62. ASTRACTURA.

Arms without terminal spine, trapezoidal, 0.05 long.....ordinata.  
 Arms without terminal spine, nearly trapezoidal, 0.1 long....aristotelis.  
 Arms without terminal spine, club-shaped.....clavigera.  
 Arms with terminal spine, about twice as long as broad.....democriti.

## 63. PENTACTURA.

Arms nearly square.....pentactis.

## 64. PORODISCUS.

Nine rings concentric ; pores 2-2½ on each ring .....orbiculatus.  
 Eight rings concentric ; pores 1½-2 on each ring.....concentricus.  
 Six rings concentric ; pores 2-3 on each ring .....heterocyclus.  
 Five rings concentric ; pores 1 on each ring .....macroporus.  
 Eight rings spirally convoluted ; pores 1½-2 on each ring.....spiralis.  
 Four rings in a double spiral ; pores 2-3 on outer rings.....bispiralis.  
 Four rings partly concentric, partly spiral ; pores 2-6 on different rings.  
 .....deformis.  
 Six rings partly concentric, partly spiral ; pores 2-4 on each ring...irregularis.

## 65. PERICHLAMYDIUM.

Rings concentric ; pores about 2 on each ring.....prætextum.  
 Rings convoluted ; pores 3 on inner ring.....spirale.

## 66. OMMATODISCUS.

Disk elliptical ; 5 chambered rings round central chamber.....fragilis.

## 67. STAURODICTYA.

Sixteen rings ; margin between spines dentated.....grandis.  
 Eight rings ; margin between spines ciliated.....splendens.  
 Four rings ; margin between spines smooth.....ocellata.

## 68. STYLODICTYA.

All rings concentric ; 8-12 spear-shaped, sulcated spines.....hastata.  
 All rings concentric ; 8-12 or more bristle-shaped spines.....gracilis.  
 All rings concentric ; 24-30 or more bristle-shaped spines.....multispina.

Outer rings concentric, inner convoluted ; 20-40 bristle-shaped spines.

..... setigera

All rings in a double spiral ; 20-30 different spines .....echinastrum.

All rings in a half spiral ; 8 conical spines .....clavata.

#### 69. STYLOCHLAMYDIUM.

Rings partly concentric, partly spiral ; centre of disk spongy .....spongiosum.

#### 70. HYMENIASTRUM.

Arms  $2\frac{1}{2}$  times as long as broad, with terminal spine.....ternarium.

#### 71. EUCHITONIA.

Odd arm  $1\frac{1}{2}$  times as long as paired arms ; patagium enveloping arms.

..... stohrii.

Odd arm somewhat larger than paired arms ; patagium nearly enveloping arms.....

..... mulleri.

Arms nearly alike ; patagium enveloping about  $\frac{2}{3}$  of arms .....triangulum.

#### 72. STAURALASTRUM.

Arms nearly spherical at ends, edges parallel.....antiquum.

Arms truncated at ends, edges divergent.....staurolonche.

#### 73. HISTIASTRUM.

Arms at truncated end a little broader than at base ; 1 terminal spine.

.....quaternarium.

Arms at truncated end 3 times as broad as at base ; 1 terminal spine.

..... gladium.

Arms at nearly spherical end 3 times as broad as in linear part ; 5 terminal spines.....

..... coronatum.

Arms in egg-shaped half 3 times as broad as in linear half ; 10-12 terminal spines.....

.....circulare.

#### 74. STEPHANASTRUM.

Ends of arms connected by ribbon shaped patagium.....rhombus.

#### 75. PENTINASTRUM.

Arms globose at ends; patagium complete.....goniaster.

#### 76. SPONGODISCUS.

No concentric rings; numerous radial beams.....resurgens.

Eleven-twelve concentric rings; no radial beams.....spongocyclia.

#### 77. SPONGOTRIPUS.

Spongy disk circular ; radial spines pyramidal.....neumayri.

#### 78. STYLOTROCHUS.

Eight-twelve long, bristle shaped marginal spines.....arachnius.

Sixteen-twenty short marginal spines.....craticulatus.

Four large and 12-20 or more smaller marginal spines ..... rhabdostylus

Four genera were omitted in the key to the Genera, namely, *Cannartiscus*, *Astrophacus*, *Amphicyclia*, *Coccoeyclia*.

*Cannartiscus* should be inserted between *Cypassis* and *Cannartidium* (p. 228, Journal, August 1893) and the Key should read :—

Two polar tubes ; medullary shell simple.....*Cannartiscus*  
Two polar tubes ; medullary shell double..... *Cannartidium*

*Astrophacus* should be inserted after *Heliodiscus* (p. 229) and the key should read :—

Medullary shell double.....*Astrophacus*

*Amphicyclia* should be inserted after *Stylocyclia* (p. 229) and the key should read :—

Two opposite spines; medullary shell simple .....*Stylocyclia*  
Two opposite spines; medullary shell double.....*Amphicyclia*

*Coccoeyclia* after *Astrocyclia*, thus :—

Five, ten, or more spines; medullary shell simple ..... *Astrocyclia*  
Five, ten, or more spines ; medullary shell double.....*Coccoeyclia*

*To be Continued.*

## Expert Examination of Handwriting.

By JUSTICIA.

CHICAGO, ILLINOIS.

A case was recently tried in Duluth, Minnesota, involving about \$400,000 which depended on the proof of a written contract of marriage. The contract was in the following form :

“Stony Point, Duluth Tp., St. Louis Co., Minnesota.

*January 6th, 1892.*

*Contract of marriage between N. Hulett and  
Mrs. L. A. Pomeroy.*

Believing a marriage by contract to be *perfectly lawful*—we do hereby agree to be *husband and wife*, and to hereafter *live* together as such.

In witness whereof we have hereunto set our hands the day and year first above written.

N. Hulett.

L. A. Pomeroy.”

The body of the instrument, it was admitted, was in the handwriting of Mrs. Hulett, one of the parties to it. The signature, “N. Hulett” and the two lines above it

forming the attestation clause, were claimed to be a forgery and written probably, by Mrs. Hulett.

There was something of a romance involved in the case. It seems that Miss Adams in her early days was a school teacher and while teaching, met and became engaged to Mr. Hulett, but for some reason the engagement was broken off and Miss Adams subsequently married a Mr. Pomeroy. After some years his health failed, and Mr. Hulett learning of it, brought both him and his wife to his own house and there kept them until Mr. Pomeroy died. After the latter's death, Mrs. Pomeroy was for a time Mr. Hulett's housekeeper. Both of the parties were believers in spiritualism, and neither of them seems to have cared to mingle very much in society or to be connected with any church. Apparently the old affection had never died out, for a few months after Mr. Pomeroy's death, Mr. Hulett renewed his offer of marriage and it was accepted. According to the testimony given at the trial, partly because he was then advanced in years, and Mrs. Hulett was some 25 years his junior in age, partly because her husband had only been dead a few months and partly because they did not believe in the orthodox forms of religion, they made what is called a common law contract of marriage and evidenced it by the above paper.

It was kept a secret (except that Mr. Hulett admitted it to two or three friends), until his death about six months later. In the fall of 1893 a will which had been made when Mr. Hulett was still a young man and possessed of very little property, was found and admitted to probate. Shortly after, Mrs. Hulett filed a petition to have the homestead assigned to her as the widow of the deceased and also to set aside the probate of the will. In support of her claim she introduced in evidence the above contract, claiming she had been married to Mr. Hulett for some months before his death. Her petition

was refused and an appeal was taken to the District Court of St. Louis Co., at Duluth, and it was tried in November last. It seems that after the contract was made Mrs. Hulett lost it and did not find it until three or four months after Mr. Hulett's death.

During the interval between his death and the finding of the paper, she denied to one or two persons that she was married, but admitted at the same time she had lost a very valuable paper which if she could find would make everything right. The fact that she denied that she was married, was brought up at the trial as tending to show that a marriage had never taken place, but the paper had been made up by her to substantiate her claim to dower. On the trial the principal expert for the plaintiff was Henry L. Tolman, of Chicago, who testified that the attestation clause and the name of Mr. Hulett were genuine.

According to the laws of Minnesota, it is competent to introduce in evidence any papers proved to be genuine writings or signatures of the person whose name is alleged to have been forged, which may be used for comparison with the contested document. Under this ruling a number of checks, letters and other papers were introduced. Mr. Hulett's handwriting was very peculiar in the fact it varied not only from time to time, but in the same letter to a very unusual extent. He would often commence a sentence in a backhand, then write a vertical hand and then end with a running hand, and his variations in angle or slant and form and size of letters, and the like, was so great as to render it very difficult to establish any satisfactory standards of writing.

In support of his testimony, Mr. Tolman had prepared a copy made with the camera lucida under the microscope, of the whole attestation clause including the signature of Mr. Hulett. The original was magnified eight diameters and the two lines of writing were thus en-

larged to about five feet in length. Another magnified copy of the same words taken from the standards was also made, magnified to the same size and both were mounted on boards and used in the case, thus affording an unexampled opportunity to compare the standards with the contested clause.

The attestation clause was written in an unusually good hand for Mr. Hulett, and this was one of the objections which was made to its genuineness. One of the witnesses for the defence was the cashier at the bank where Mr. Hulett kept his account, and another was the vice-president of the same bank, both of whom testified that the signature was forged. The trial lasted a week and the jury returned a verdict in favor of Mrs. Pomeroy, holding that the signature and the attestation clause were genuine.

The time occupied in making these copies of the attestation clause was about eight days, and they are probably the largest camera lucida drawings ever introduced in a court on a trial. Their accuracy was proved by a preliminary examination of the witness, and as the defence somewhat singularly, did not make any exceptions, they were admitted in evidence and allowed to go to the jury.

The validity of the use of camera lucida drawings by a witness has been questioned a number of times, but the right to use them is as well established in the courts as the use of prints or diagrams or photographs in illustration of a witness' testimony. They have, however, never been admitted in evidence as documents where objection has been made, though on principle they are equally admissible with photographs. Indeed, according to the sworn testimony of Mr. Tolman on the stand, they are more correct than an enlarged photograph can be, owing to a radical deficiency in the ordinary photographic lens.



In order to guard against ordinary errors of spherical aberration in making the drawings, Mr. Tolman constructed a movable platform with double rectilinear motion on which the microscope traveled across the table, as it was impossible to get more than a small portion of the attestation clause in the field of the microscope at one time. Besides the drawings before described there was a camera lucida copy of the signature and photographs of a number of checks, letters, etc.

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### A Convex Illuminator.

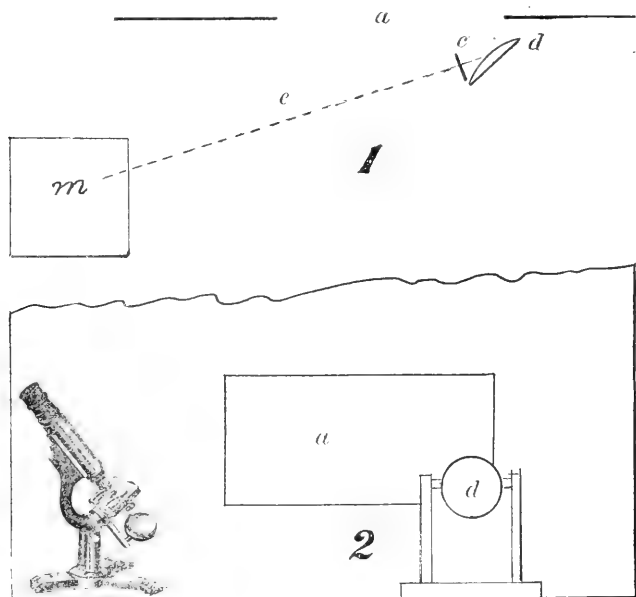
BY PROF. WILLIAM LIGHTON,

OMAHA, NEBRASKA.

During the past year I have examined and tested several homogeneous immersion objectives for friends, using *Amphipleura pellucida*, mounted in balsam, styrax, Smith's medium and dry, and during these experiments I have used a little piece of apparatus which I invented some time ago, with such comfort and success that I really think a description of it may be of interest and help to microscopists using high power homogeneous immersion objectives. I have found, in quite an extensive series of experiments that many objectives fail to do their best when using oblique light, because of the use of too large lamp-flame, coupled with too great diameter to the concave mirror. Now, a small flame does not give sufficient illumination without the use of a condensing lens of considerable diameter, and that is quite as bad. The plan now proposed is to use sunlight in the manner to be described, and the apparatus need not cost more than a dollar or two, and it can be used for either visual work or photography.

A plano-convex lens of about four inches diameter and six inches focus is obtained and the plane side is painted black with paint that will not crack. The object of this paint is to destroy the internal reflection from the plane

surface of the lens. The polished surface of the lens will reflect light not only with a reduced intensity, but the reflection will be of greatly diminished size, as it acts like a convex mirror. If sunlight is allowed to fall upon the convex surface, an exceedingly small and brilliant image of the sun will be seen upon it. If the convex reflector is properly placed with reference to microscopical work, the direction of illumination will remain quite constant during several hours of work.



The plan I have found best is to close the blinds of my room and leave an opening in the window I am using about twelve inches long and six inches wide. My window faces south, and the opening is in the middle of the lower sash and about ten inches from the bottom of the frame. Sunlight enters this opening quite early enough for work, and is available for several hours during the day.

All that is necessary to be done is to mount the convex reflector on some form of stand which will allow it

to be moved in a vertical direction, and it should be placed as near the opening in the window as possible so as to receive the sun's rays. The convex surface should be placed toward the sun, and for morning work should be at the right hand of the opening, and in such position as to reflect light towards the microscope, which is placed at the left side of the window and about two feet from the convex reflector, as shown in the figures. Fig. 1 is top view of the plan, and Fig. 2 is a side view of the same; *a* representing the opening in the window; *d* the convex lens and *m* the microscope. Light from the sun, during the greater part of the forenoon and part of the afternoon will be received by the convex surface near the center of *d* and will be reflected to the microscope as shown by the dotted line *e*.

For work in the afternoon, the convex reflector can be placed at the left of the opening, and the microscope at the right. With this one change, work can be carried on through the greater part of the day.

Polished glass reflects but a portion of the light that reaches its surface, and the convex form of the reflector disperses the reflected light to such a degree that it gives just the illumination needed for delicate work with very high powers.

In using an achromatic condensor, I have placed a disk of ground white glass about three-quarters inch in diameter as near the convex surface of the reflector as possible, as shown at *c* in figure 1. The image of this disk can be focussed upon the object by the condensor. This gives a beautifully clear white light. The ground glass should, of course, be placed between the image of the sun on the convex reflector and the object upon the stage of the microscope. This reflector works well with all forms of illuminating apparatus. A shield should be placed at the opening of the window in such a manner as to prevent the light from the sky

entering the microscope. When using an achromatic condensor in the sub-stage I have found the best resolution of *Amphipleura pellucida* obtained by the use of a very small opening in the sliding diaphragm—much smaller than usually used.

If the concave mirror is used, its diameter should be reduced to small size by a hole in black card-board placed over its surface. I rarely use the concave mirror with this illuminator however.

With the use of a hemispherical lens under the object, and the microscope so placed that direct light from the convex reflector is carried to the extreme edge of the objective, *Amphipleura pellucida* mounted in balsam can be superbly resolved, if the objective is a good one.

A little practice with this illuminator will soon make the microscopist familiar with its use.

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### EDITORIAL.

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**The American Society of Microscopists.**—Our editorial in the last number seems to have attracted considerable attention as communications are constantly arriving in regard to the subject. The discontent and consequent apathy seems to be more wide spread than we at first supposed, and we are getting many clues to the situation.

The most amazing thing, perhaps, comes from the Brooklyn microscopists who actually did not realize that the meeting was to occur in their midst. Several to whom we have written for their impressions of the meeting did not attend, did not know that there was anything to see or hear, had not been asked to prepare papers, to arrange for microscopical instrument exhibits, to attend working sessions, to loan microscopes, etc. "Why", say they, "did you not tell us in the JOURNAL what was expected of us and what we might expect to enjoy." Simply, because we could not find out that anything was expected nor that there would be anything to enjoy. The Secretary of the Society lives just four blocks from our office and has been repeatedly asked to furnish matter for publication

during the whole three years of his incumbency, but he has never handed us one single line of manuscript. When he has had printed or hectographed matter for general distribution he has sometimes but not always furnished us with copy. He has known perfectly well that we should be only too happy to publish everything regarding the meetings of the Society. But the Secretary is a man of some sense, of some idea of the fitness of things. Having a rule in his Society forbidding people to give us their papers for immediate publication, and, not content with the Annual Proceedings of his predecessors, having succeeding in inaugurating at the Society's expense (don't forget that) a new periodical to compete (?) with us, and (please do not laugh) to rival the Journal of the Royal Microscopical Society, and having, when he wished to criticise a paper in our columns, gone off to the wilds of Michigan to find a weekly paper in which to utter his denunciations,—having done these silly things, he has had the good sense to know that he ought not to ask favors of us, or to permit us to help make his Society (for it seems to be his) and his new Periodical a success.

But aside from a commendable sensitiveness such as we have described, there has been another insuperable barrier to his furnishing us data regarding approaching meetings of the Society, i. e. he had practically none to communicate. When he started for Brooklyn he did not know what was to occur there. Much less could he have told us in time to put it in the July issue. The same was true in 1893 of the meeting at Madison, Wis. but The World's Fair was made to carry the blame of the abject failure of that meeting. But of the 1892 meeting held here in Washington, also nearly a failure, no possible excuse could be offered. Although Mr. Smiley was in Europe, the columns of the JOURNAL were open to announcements regarding the approaching meeting at which the Secretary had prophesied there would be 100 members present, but nothing was furnished. Consequence, not 35 members were here from out of town.

Of course, the Secretary sends an announcement of his own to the members, but here again is a difficulty. His list is antiquated and out of date to some extent. Many people pay no attention to free circulars who would read announcements in their periodicals which they have to pay for. Circulars get

mislaid, are lost. Magazines are filed and can be found for reference. But one announcement is not sufficient. There should be something in every issue from April to August about the approaching meeting. This year we intend to have something about the Society in every issue from February to August whether the Secretary furnishes it or not. We can if need be make bricks without straw.

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### **MICROSCOPICAL APPARATUS.**

**Ross's Petrological microscope.**—This microscope is designed to provide a thoroughly reliable instrument for students in petrology. In size and form it resembles the "Eclipse" pattern (with *reversible* foot to ensure stability in any position). The stage is circular, revolving, and the periphery divided into 360°. The analyser, which can be drawn out when not needed, is fitted into the lower end of the body tube, where also a slot is cut at the angle of 45° for the insertion of a quartz wedge, etc. The polarizer is pivoted to swing out of the field when so required, and it has a circle divided into 8, clicked at 0° and 180° to indicate when the Nicols are crossed. The eye-piece is furnished with crossed webs and readily drops into a slot. The milled-head of the micrometer screw is divided to measure 1.500 of an inch motion of the fine adjustment. Plane and concave mirrors are provided. The price of this capital instrument, with one eye-piece, 1½ and ¼ object glasses, double nose-piece, (adjusting object glasses to same focal plane), polarizing and analysing prisms, and Klien's quartz plate, mahogany case, is \$50. A number of accessories fitted to the petrological microscope are listed by the makers, Messrs. Ross, of New Bond Street, at very moderate prices.—*The Optician, London.*

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### **MEDICAL MICROSCOPY.**

**The Duration of the Contagiousness of Diphtheria.**—The *Journal des Praticiens* for January 19th contains an article in which the writer remarks that this question is the subject of much controversy. A young physician, M. Tezenas, recently collected sixty observations of patients who were attacked with characteristic diphtheria, and he divided these cases into three

series, and made a bacteriological examination of the products taken from the bucco-pharyngeal mucous membrane and from the nasal discharge. The following results were obtained: In the first series, in forty-four cases, the mucous membrane did not present any false membranes and there was no nasal discharge. On bacteriological examination, the cultures showed no bacilli, except in three or four cases where Loeffler's bacillus disappeared after four days. In the second series in five cases the mucous membrane was divested of its false membranes and the nasal discharge dried up. Nevertheless, Loeffler's bacillus persisted from twelve to twenty-eight days. In the third series, in eleven cases the nasal discharge persisted, and the cultures with this discharge were positive, although those of the products drawn from the bucco-pharyngeal mucous membrane were negative. The presence of bacilli in the nasal discharge was observed for from five to thirty-five days. These facts, says the writer, lead to the following practical conclusions: 1. In a number of cases the metadiphtheritic contagiousness ceases with the disappearance of Loeffler's bacillus. Nevertheless, the irritated condition of the bucco-pharyngeal mucous membrane, under the influence of intercurrent measles, favor the increase of the bacilli and their presence in the mouth; hence the necessity of a bacteriological examination of the products taken from the mucous membrane of this cavity. 2. Not infrequently (in eleven cases out of sixty) Loeffler's bacillus disappears from the throat, but is still in the nasal discharge. The trouble is thought to be common coryza, which is a mistake, as this discharge is not accompanied with any symptoms of classic coryza. There is no conjunctival injection, or headache, or watering of the eyes. Ordinarily it is unilateral. The discharge is a transparent mucus and by no means the sanious discharge which succeeds false membranes of the throat. 3. According to M. Tezenas, Loeffler's bacillus exists in the nasal cavities as long as the nasal discharge continues, and disappears when it does. He adds that when this discharge is absent there are no bacilli in the nose.

In practice, then, says the writer, this fact must be taken into consideration, that a nasal discharge the origin of which does not coincide with the disappearance of the false membranes is diphtheritic. It does not contain Loeffler's bacillus. The bac-

teriological examination proves that unquestionably.—*N. Y. Med. Journal.*

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### MICROSCOPICAL NOTES.

**A. A. A. S. Meeting, 1895.**—At a special meeting of the Council, held on January 26th, it was decided to postpone the proposed meeting in San Francisco. An invitation from Springfield, Mass., to hold the meeting of 1895 in that city, was accepted. The date of the meeting was fixed as follows: Council meeting, Wednesday, August 28th, at noon; General Sessions, Thursday, August 29th, at 10 A. M.

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### NEW PUBLICATIONS.

*Lens-Work for Amateurs.* By Henry Orford. 12° 231 pp., 231 illustrations. London and New York, 1895. Cloth-Cover, 80 cts.

A man who thoroughly understands both the practical and the theoretical phases of lens-making has undertaken with the aid of 231 diagrams to tell us not only how he would perform every step in such work but to give us the mathematical and other reasons therefor. With the aid of the book, a man of mechanical capacity may learn to do all such work. The book is primarily, a technological hand-book. Many a young man has served a three to five years apprenticeship in order to learn what he can now buy for eighty cents. With the acquisition of such books relating to the various trades will come a solution of the trades-union difficulty which limits the number of apprentices and seeks to artificially increase wages by reducing the number of work-men.

But the book has a value for every microscopist who wishes to handle his lenses intelligently or who wishes to understand the optics of magnification. All kinds of lenses, condensers, paraboloids, illuminators, eye-pieces, iris diaphragms, camera lucidas, polarizers, and tools for making them are described from the artisan's standpoint. We refrain from saying that the diagrams appear to be second-hand and badly worn and the language sometimes faulty, because the book is so exceedingly cheap in price and the artisan-author so capable, so painstaking and a true philanthropist. Microscopists will not need that we tell them to expend eighty cents for such a book.







R. H. WARD, M. D.,  
PRESIDENT, POSTAL MICROSCOPICAL CLUB.

# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

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### Antheridia of a Moss.

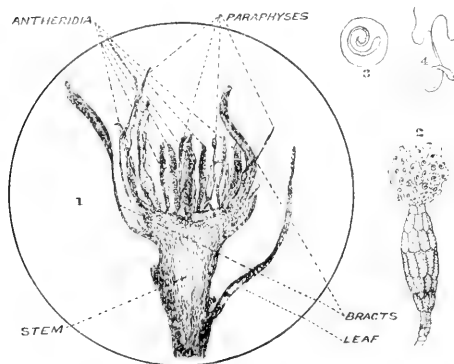
By R. H. WARD, M. D.,

TROY, N. Y.

(From Note book A, of the American Postal Microscopical Club.)

WITH FRONTISPIECE.

This longitudinal section (Fig. 1) through the summit of the Hair-cap moss (*Polytrichum*) gives a clear display of the male reproductive system or sterile "inflorescence" of the mosses. Though not a flower, in any sense, it is doubly interesting from its rough resemblance to one



in general aspect, and its still greater resemblance to a head of flowers like an aster or solidago.

The essential portion consists of the several slightly stalked (*pedicelled*) cylinders on the discoid summit of the stem. These, which produce the male reproductive bodies (*antherozoids*), are well called antheridia from their analogy to the anthers of a flower.

The morphological character of the antheridia is not as obvious or as uniform as that of the (corresponding) stamens in the higher plants. This might be expected

in a family of such meagre development, where the trichome root-fibers still take the place of specially organized roots, and which is just above the plane of evolution where stems and leaves have become differentiated from each other. The antheridia seem sometimes to be formed by a direct prolongation of the axis itself, or else of lateral shoots (branches) from it; sometimes to represent leaves (as stamens do); and sometimes they appear as trichomes (hairs) by their development from cells of the epidermis in indefinite numbers and positions.

In our object, as shown (X15) in figure 1, they might, from their appearance and position, be either branch-shoots, like the separate flowers in a head of daisy; or leaves, like the stamens of a buttercup; or trichomes, like the sporangia of the ferns. The last theory might seem most plausible, from their own appearance and that of the plant as compared with the ferns, but it would involve the more or less improbable combination of two different sorts of trichomes, these and the paraphyses, in the same cluster, and without the intermixture of any abortive or intermediate forms; the first theory, likening them to the flowers in a composite head, is also tempting, but this would suggest the paraphyses (which seem plainly trichomes, and not leaves) as representing the leaves, like the scales or chaff in the flowering heads of the *Compositæ*, to which these antheridia would be, however disguised, axillary branches; the second theory, likening them to ordinary stamens, besides fitting well to themselves, accounts easily for the paraphyses as hairs growing on the neighboring portions of the stem, which seems on the whole the most reasonable and probable. If the paraphyses be considered abortive leaves, then the antheridia would be considered branches. Further evidence of their real nature should be sought at an earlier stage of growth.

The antheridia are often clustered, as here, on a dis-

coid enlargement of the top of the stem, and mixed with fine succulent hairs (*paraphyses*) which were formerly considered either abortive antheridia or abortive leaves, but which seem more like typical trichomes (hairs) of a distinct and well developed character.

The outer portion of the cluster consists of a somewhat bud-like involucre (*perigonium*) formed of whorls of leaf-like bracts, which are efficient for the protection of the antheridia while developing, and for the retention about them, when mature, of sufficient moisture to facilitate the escape and migration of the antherozoids.

The whole arrangement is seen to present, under the 1- or 2-in. objective, a striking likeness to the section of a flower, or of a composite head of flowers, and it is sometimes called, for the sake of brevity, the flower, or inflorescence, of the moss; though always with a mental protest against such an unfortunate and confusing misuse of those terms.

Each antheridium consists of a sac-like wall formed of a layer of tabular, chlorophyll-cells, as shown ( $\times 100$ ) from another moss (*Funaria*) in figure 2, which turn yellow, like nearly all true anthers, or red when ripe. Within this enclosing wall may be found numerous smaller, spherical cells, which will finally burst out in a mucilaginous mass from the top of the sack; each sperm-cell (fig. 3,  $\times 1000$ ) containing a filiform, spirally coiled antherozoid, shown after escape from its mother-cell in fig. 4.

The antherozoids are evidently assisted by the pair of cilia, at the thin anterior end, in moving freely through the moisture often present in the spongy mass of clustered leaves and hairs, to reach the flask-shaped female organs (*archegonia*) and fertilize the contained germ-cell (*oosphere*). Though representing in function the pollen grains of a flower, they so strikingly resemble in general appearance, activity and use, the spermatozoids of many

animals that some authors have given them the same name. Their form and character are exquisitely adapted, in both cases, to their use ; being long, slender and flexible, they can swarm about, progressing rapidly with a vibratory motion, and come in contact with every surface exposed to the liquid in which they find themselves ; and the tapering anterior end readily enters any chink or crevice that may be present, and insinuates itself deeply into small cavities or loose tissues beyond, thus leading or opening the way for the larger mass of fertilizing protoplasmic material, that forms the olive-shaped enlargement at the other end, to reach the germ-cell that requires fertilization.

The subsequent development of the fertilized germ-cell into the asexual spore-case (*sporangium*, or *sporogonium*) as it rises on its stalk from the top of the foliaceous plant of which it often becomes the most conspicuous and admired portion, and of which it is popularly called the "fruit", though it is a non-sexual member producing spores that are analogous to buds, not seeds, is one of the most interesting studies that can be made by the thoughtful microscopist who frequents the fields at the proper season of the year.

It is not often easy, unless for an experienced botanist, to find and identify the spores which have been scattered as a powdery dust, and lost to sight amidst the debris upon the moist soil, in order to observe their germination, and the growth from them of a filamentous vegetation (*pro-embryo*, or *protonema*) which in turn produces, by lateral budding, the familiar moss plant, a sexual state (*oophore*) bearing archegonia and antheridia like our specimen. It is, however, an easy and comparatively unfamiliar experiment to sow the spores on clean sawdust or cotton wool, or on blotting paper, kept damp beneath a bell-glass, and to watch, at home and at leisure, the various stages of this most interesting history.

## The Enteron of the Cayuga Lake Lamprey.

BY AGNES M. CLAYPOLE,

AKRON, OHIO.

[ABSTRACT.]

The purpose of this investigation was to work out as thoroughly as was possible the enteric structure of the Cayuga Lake Lamprey, *Petromyzon dorsatus* Wilder. With the exception of an article by S. H. Gage "On The Lake and Brook Lampreys of New York" no special studies have been made on the structure and metamorphosis of the North American Brook and Lake Lampreys.

Material for this work was obtained during 10 months of the year and many different hardening and staining fluids were used. Owing to the three distinct natural stages in the animal's life, the larval transforming and adult forms were studied separately.

The larval enteron was found to be a nearly straight tube running the length of the body. The liver contained, buried in its tissue, a large gall bladder from which a duct led to the intestine. Alongside of the duct ran the coeliac artery which entered the typhlosole of the intestine. The portal vein arises on the outer wall of the intestine at its caudal end and finally becoming free enters the lower end of the liver.

The tissue of the larval intestine is composed of a muscular and a mucosal layer. The former has an outer longitudinal and an inner transverse layer. The cells had the usual appearance of unstriated muscular tissue. Between this layer and the mucosa is a cavernous space full of blood vessels. The mucosa is a single-celled layer of epithelial cells, tall and columnar. Although there are no groups of cells such as commonly called glands, there is a differentiation of the epithelium for purposes of absorption and secretion. There are groups of ciliated cells at certain places but only at the cephalic

end of the canal. Between these ciliated areas are cells that have a distinctly striated border and contain in many cases large yellowish globules. At other places there are cells which stain differently from the rest and are filled with coarsely granular material.

To determine the exact functions of these cells would require a careful series of physiological experiments, only a few were tried, but these proved very suggestive. A larva was put in a mixture of milk and water and left there for several hours. Milk was found firmly coagulated throughout the length of the intestine and the amount of golden yellow material present in the cells was much increased. A similar experiment was tried with raw starch instead of milk; the results were similar excepting that the amount of yellow material in the cells was not as great as in the case of milk-fed larva. The intestine of a specimen taken from running water showed a small quantity of the same colored material in corresponding places.

Parts of the intestines of these artificially fed larvæ were hardened in osmic acid. Tissue from the milk-fed one showed the presence of numerous blackened granules in the striated-bordered cells and underlying muscular and cavernous tissues. The tissues of the starch-fed larva showed granules in corresponding places but in no case with any tendency to blacken. These experiments suggest almost to a certainty that these striated-bordered cells are absorptive in function; this agrees with the views held in regard to similarly striated cells that are found in the alimentary tract of the frog.

The liver of the larva is simple and tubular in structure. Much fat was found to be normally present in its cells while many granules resembling those present in the striated-bordered cells of the alimentary tract are found in an intercellular position.

The adult enteron has undergone extensive modifica-



tions compared with the simple larval tube. There is a distinct esophagus which leads into a much twisted and elongated intestine. The mucosa of the whole alimentary tract is prolonged into many folds which nearly fill the lumen of the canal with their mucosal plates. The intestine is throughout the greater part of its length entirely free in the body cavity but at its caudal end it is dorsally connected by fine bands which are vascular in nature. The largest is an artery of considerable size that enters the typhlosole and flowing toward the head anastomoses with the descending mesenteric artery. The external portal vein of the larva is gone and a large vein now flows in the typhlosole with the mesenteric artery and empties into the liver. At its caudal end instead of becoming smaller it passes out onto the outer surface of the intestine and forming together with the artery before mentioned a large band, enters a large blood sinus lying between the two cardinal or body veins. By injection this sinus was found to terminate blindly at its anterior end; the flow of blood through it was caudad. Receiving all the blood from the gonads and kidneys it evidently serves to introduce a large amount of venous blood from the urogenital and body veins into the portal system. This connection between these two systems gives these Marsipobranchs another feature in common with the very dissimilar members of their group the Myxinoids.

The liver is bright yellow during most of the animal's life but turns dark green during the spawning season. There is no gall bladder and consequently no gall duct.

The muscular walls of the intestine are but slightly developed. The epithelium is composed of a single layer of columnar epithelial cells of which there are three distinct kinds, ciliated cells, striated-bordered cells and granular, non-striated, non-ciliated cells. The surface of the epithelium is at irregular and frequent intervals de-

pressed into pits which are lined with the striated-bordered cells; on the areas between the pits are the ciliated cells, and scattered irregularly among them all are the granular club-shaped cells.

An experiment was tried with milk similar to the one tried on the larvæ with practically similar results. On treatment with osmic acid blackened granules were found in the striated-bordered cells and underlying tissues.

It is evident from the above descriptions that profound changes take place during the transformation from the larva to the adult. A good series of larvæ was studied with the following results: The esophagus of the adult develops very early in transformation. The first stage in the changes of the alimentary tract seems to be a loss of definite structure followed by a rapid cell increase and enlargement of the size and length of the intestine. The gall bladder and ducts disappear and the liver loses its simple tubular structure.

Externally the mouth has gained its sucker-disc and the skin is sheeny and gray. It was found that the time required for these changes is probably not less than seven or eight months, from August to March at the end of which time the animal is ready for its parasitic life.

During spawning season the last changes known to take place in the life of the animal occur. In some respects these are the most striking of the series of modifications to which the digestive tract is subjected. At a date estimated to be from two to three weeks previous to egg-laying a sudden increase in the size of the gonads of both sexes takes place. This is accompanied by an equally sudden and rapid decrease in the size of the intestine. The liver changes to dark green. By the time the sexual products are mature the intestine is reduced from a tube of 1 to  $1\frac{1}{2}$  centimeters in diameter to one of 2 to 3 millimeters.

The epithelium of the intestine is low and cubical and the folds of mucosa are much reduced in size and number. There are many small fat-like globules in the cells and underlying tissues that blacken or at least become dark brown in osmic acid. On the whole there is no appearance of dissolution in the tissue; the changes are simply of reduction and there is apparently no reason why reconstruction should not take place. This bears upon a still undecided and much disputed point as to whether lampreys die after spawning or live to another season.

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Extract from Report of Management of the American  
Postal Microscopical Club for 1893-95.

By R. H. WARD,

TROY, N. Y.

MEMBERSHIP.

One Circuit was dropped during the last season, on account of such habitual and endless negligence and carelessness that the Club's circulation could no longer go on. Any members who may think it a trivial offense to lose two or three boxes or note books, and stop all the rest that reach them, and then consider it troublesome and annoying to be asked to report what they or their neighbors have done with them, or else answer gaily that they must be lost somewhere, could understand, by a little intelligent reflection, that this is simply destroying the Club.

The Presidency being vacant, it was thought convenient to simplify the affairs by appointing the two Managers as President and Vice-President and dropping the former title. This will not cause any practical change in the management or policy of the Club. The Secretary, Dr. Shanks, will continue in the position which he has occupied with efficiency and success for two years past.

Since the time of the last report we have suffered the loss by death of several of the oldest and most experienced and representative members, who have been active and efficient in the Club since its earliest years.

#### SLIDES.

The average character of the slides circulating during the last year or two has been exceptionally good, mainly on account of the special Da series which was added to the regular circuit boxes. There was nothing new in the character or use of the special boxes. Ever since the Club was founded it has been favored with frequent boxes illustrating the work the more active members were doing in their specialties. About a hundred such special boxes have been accepted and circulated, to the great interest and profit of the members. But it has not been attempted, before, to get together enough at one time to make a complete series. When the formation of such a series was under consideration, and the writer, with some doubt as to whether the members and the management could find the time required, expressed a fear that a half year's work would be required to accomplish it, some members were inclined to regard the statement as a joke. It was not a joke, but it was certainly a mistake. At that time, in March, 1891, much work having already been done in conference and correspondence, a well-elaborated plan was published and explained, both in the Annual Report and in a special circular, and every effort was made to carry on the work promptly; but the series was not completed and ready to hand over to the Secretary for service until exactly two years later, in March, 1893. This is only a part of the truth, however, as some of the promised boxes, including those expected from some members who were most certain that it would be no responsibility to enter upon such a scheme and no trouble to carry it out, are not in yet—after the series has been in use nearly two

years. This is not stated to find the least fault with anybody for not doing more than he can, but as a curious little example of the amount of work required to carry on the Club, and as a hint, perhaps, to any members who may happen to imagine that the officers lack only inclination in order to set an example of promptness in everything.

It would be impossible to specify all to whom we are indebted for contributions and assistance of various kinds in preparing this series. Those who supplied full boxes of slides, with elaborate notes, were Drs. E. J. Attinelli, J. M. Lamb, George A. Rex, F. A. Rogers, S. G. Shanks, W. H. Sylvester and D. B. Ward, Professors Charles H. Clark and H. N. Conser, and Messrs. E. A. Hill, J. D. Mallonee and Lewis Woolman. Photographs more than equivalent to full boxes of slides were furnished by Dr. D. B. Ward and Messrs. Frank Ritchie, George E. Ashby and Thomas Christian. Many notes of professional grade and authority, were furnished for slides that required them by Professors Harry M. Kelly and Henry B. Ward, and Dr. S. G. Shanks. The present writer, besides the constant care and labor of keeping up the work during its whole progress, having long been unable to give any time or thoughts to preparing slides, tried to do his share by contributing about 150 pages of typewriter notes, double close, which would make 300 pages as usually spaced. As many were prepared with much care, the labor involved was considerable. Several of these, being intended for general reading, have been published in the journals as explained elsewhere.

Under the stimulus, perhaps, of the work on the special series, the last set of circuit boxes was of more than ordinary importance. Subsequently, individual special boxes of value have been contributed by Professors Charles H. Clark and Harry M. Kelly, Mr. F. F. Forbes and Dr. D. B. Ward.

Such remarks as this, "I have spent many pleasant hours over the many excellent and instructive slides," made by a distinguished authority, and which is a fair example of many others received, must be a reward to those accomplished members who give much time to the good work.

#### NOTE-BOOKS.

Although the slides cannot be always absolutely novel, among the hundreds constantly in circulation and many of them changed every year, it cannot be urged too often, or remembered too well, that every one of them could and should be accompanied by some fresh thought in the note-books. Many of the recent books have been thoroughly valuable. A selection of extracts from such notes as are available for reading away from their slides is printed herewith. As there were more of the longer class of notes than it seemed necessary to reserve for first publication in the Report, permission was given for the appearance of several, specially revised for the purpose, in the American Monthly Microscopical Journal, the Microscope, and the Observer. Separate reprints of two or three of these, now in press, will be sent to all members, instead of reprinting them in this Report. We are indebted to the courtesy of Mr. Frank Ritchie, of circuit A, for taking the photographs for use in the preparation of plates.

Occasionally a note is entered in the books with lead pencil, with a modest feeling, perhaps, that it is not important enough for a greater display. These soon become nearly invisible, and an intolerable nuisance, useful only to experts in handwriting, for practice in trying to read the illegible. Anything worth entering at all is worth making easily legible in ink. If of temporary value only, as the writers often correctly judge, it should be plainly written on a small separate slip of paper, and

pasted lightly in, so as to be readily removable when no longer needed. If intended for the present circuit only, or for the information of the officers of the club, it should of course, be written on or attached to the mailing slip only.

The value which thoughtful members, even the most experienced and highly educated, place upon the notes often comes out in correspondence or on the pages of the note-books. One of our most accomplished former members, himself an expert microscopist, distinguished scholar and professional teacher, who would have been independent of help from other people's notes, if anybody could be, once wrote: "I would suggest that members be compelled to describe specimens. This slide is absolutely valueless to me for want of a description. It is a shame that such a beautiful object should go around and do so little good, when it might just as well add much to our knowledge." If the fact that they have interested and instructed such men as our late member, Dr. M. N. Miller, does not persuade members to give their best thoughts to writing their notes, then it must be feared that no one could "compel" them to do it even if he could rise from the dead for that purpose. Another member wrote elsewhere: "Contributors should observe the rule on the cover of this note-book, calling for descriptive notes. The management must depend upon the members to do their best if they care anything for the club. The annual dues are very small, and each member ought to contribute an interesting mount, and take some pains to write a suitable note for it. If each one depended on some one else to contribute good mounts and notes what an awful disappointment would fall upon us all. The manager can only manage what the members supply." Still another member wrote in another book: "Longitudinal sections are much more difficult to interpret than transverse, and if only one series is to be

used the latter should be preferred. A series of sections should be accompanied by an extended description to enable those working in other groups to appreciate the matter in a minimum of time. We are all busy enough, and the donor of the slide can usually write an extended description with little trouble to himself and save his fellow members hours of time, if indeed they do not pass on in despair for lack of time to work it out.

#### CIRCULATION.

About the usual number of boxes has passed through the Circuits during the past two years. The few excessive delays, causing abnormal irregularity in many Circuits, have been due, as usual, to gross negligence of a very few members. Equally unnecessary, because easily avoidable, are the too frequent losses of club property. Boxes and note-books are often lost temporarily, and great injury done, by careless misdirection, or by using tags that have been used several times and are so defaced that it is almost impossible to know where they came from or are going to, or by sending without any tag or with one not safely attached, or by sending without sufficient stamps, or without Club tags and envelopes (or the only acceptable substitute, those with a personal return address plainly printed on them); but even in these cases they are generally heard from shortly. Those which are finally lost are chargeable to members who, for want of a moment's personal attention, allow them to be mislaid among rubbish or cleaned out into the waste basket by heedless housemaids or ignorant office boys. Equally due to carelessness is the breakage of slides; our boxes are practically safe, not a slide in thousands being injured while in them if properly packed, each in its proper space. They are nearly always broken by careless handling or focusing, or from careless packing. The only clear exception to that statement thus far known is that they will not, it must be admitted,



stand being run over by an express train on a railway. We have had two curious instances of this kind within a few weeks of each other, where mail bags containing our boxes were thrown off from passing trains at a way station against snow drifts sloping steeply to the tracks, down which the bags slid back under the train and were ground beneath its wheels. Whether the the people's P. O. employees are still tobogganing the people's property thus under the wheels at the same place, for no better reason than that they are accustomed to throw it there upon the grass in summer, is unknown to us. It is certainly a better field for reform than some others that might be mentioned.

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### Announcement of the Next Meeting of The American Microscopical Society.

By W. W. ROWLEE,

*Chairman of the Local Committee.*

The next meeting of the American Microscopical Society will be held at Cornell University in Ithaca, N. Y., August 21, 22 and 23, 1895, the week before the meeting of the A. A. A. S.

Considering the geographical distribution of the members, Ithaca is as central a point as can be found for the meeting. It is connected with the great trunk lines in such a way as to make it very readily accessible by railroad.

The unsurpassed beauty of the location of the University, and the richness of both its terrestrial and aquatic fauna and flora, make this an ideal place for holding the meeting. It is equally attractive to the student of natural history and to those who love beautiful scenery.

The facilities of the University and its equipment in all lines for carrying on microscopical work add to the attractiveness of Ithaca as a place of meeting. In most

of the scientific departments of the University, there are already members of the Society, and in all departments there will be a most hearty welcome, and every reasonable aid will be furnished for the success of the meeting. Finally and not least, the President of the University, Dr. Schurman, extends to the Society a most cordial welcome.

The University buildings, which will be at the disposal of the Society, are especially adapted for the formal presentation of papers, blackboard illustrations, hanging of diagrams, etc., as well as for any demonstration that authors may desire to make. The armory is very conveniently located both for the University and for the city, and a soiree there can hardly fail to be a great success.

Besides the attraction of papers and demonstrations by members, nearly all the opticians have expressed not only a willingness, but a desire to be present and make an exhibit of their microscopes and microscopical apparatus, thereby affording the members an opportunity to see all the new and standard apparatus.

If one will look over the contents of the proceedings of our Society, it will be found that, following our prototype, The Royal Microscopical Society of London, our Society not only considers and publishes papers upon the microscope, its manipulation and accessories, but also the results of investigation in which the microscope plays an important role. Indeed the papers cover the entire field of human knowledge in which the microscope is an important instrument of investigation. Thus there are articles on the microscope itself and its accessories; microtomes and section cutting; methods of fixing and hardening; indeed on all the processes that must be gone through for the successful study of modern biology. Pathology and bacteriology also have their share of attention. Jurisprudence in so far as it calls upon the

microscope for aid in detecting forgeries, erasures, etc., as well as in detecting crime is also well represented. And finally there is no modern publication in which is more fully and satisfactorily discussed the principles underlying exact standards of length, a subject vital to every user of the microscope, for if his micrometers are not exact, his work must necessarily in so far be defective. The University possesses one of Rogers' dividing engines and the department of Physics has kindly promised to show the members exactly how micrometers are made. There is also a large comparator for carefully testing micrometers after they are made. This one was actually used in determining the exactness of the rulings of our standard centimeter.

A special feature of the coming meeting will be the setting apart of one or more sessions for the reading of papers on methods and the demonstration of special or new methods. The chairman of the local committee, Professor W. W. Rowlee, or the president will be glad to receive requests from those who desire to have some specially difficult method or structure elucidated, and an effort will be made to get some member particularly expert in such subject to demonstrate it before the Society.

President Gage will be upon his own ground and all may rest assured that his enthusiasm for and energies in behalf of this meeting will guarantee a profitable time to all who come. The opportunity to observe his methods in his own laboratory is a privilege none could afford to lose even if there were no other attractions.

Please make plans at once to be present, to help bring new members, and to make the next meeting worthy of the Society.

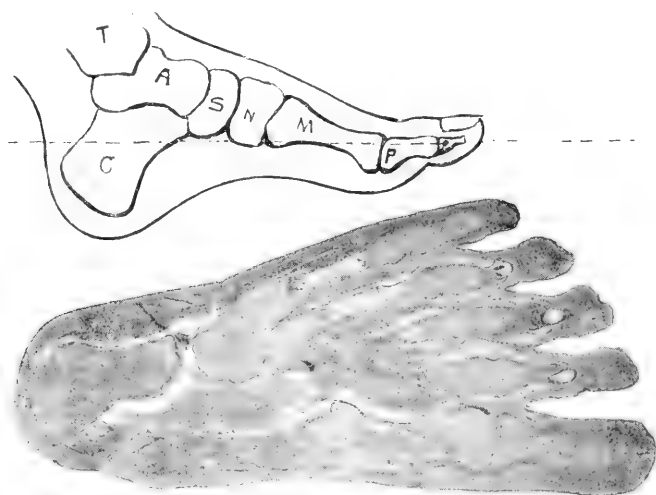
[Those who purpose attending ought to begin the preparation of papers at once and let their good intentions be known to others. Such purposes are infectious, but indifference is also infectious. We shall watch and report the preparations without fear or favor.—Editor.]

## Foot of a Human Fetus.

BY S. G. SHANKS, M. D.,

ALBANY, N. Y.

This section is shown,  $\times 8$ , in the photograph. The drawing gives a side view of a foot, the dotted line indicating the plane of the section. The fourth and fifth metatarsal bones (M) are fairly split. The toes are ordinarily flexed or turned downward, but in this case they were nearly straight, the cut passing out below the nails. The os calcis (C) or heel bone is prominently shown. In



front of it is the cuboid, which does not appear in the drawing, being behind the scaphoid (S), but it is seen in the photograph in front of the calcis and in articulation with the fourth and fifth metatarsal bones. The scaphoid (S) being high in the instep escaped the knife. Of the three cuneiform bones (N), only two are shown in the section, one in articulation with the first metatarsal bone (M), and a corner of the other facing the cuboid-metatarsal articulation. The nail on the small toe can be easily located; on the great toe the nail matrix is outlined by

darkly stained lines following the edges of the terminal phalanx. The skin of the foot shows numerous sweat glands dipping into the subcutaneous tissue. A one-inch objective or a simple lens, held in the fingers, gives a better view of the section than the compound microscope.

With a one-fourth inch objective the process of ossification is well seen. This transformation of the solid fetal cartilage has already commenced in the first phalanx of the small toe, by a breaking down of cells and a deposition of fine granules of calcareous matter; but in the first phalanx of the great toe the process is further advanced, showing a surface layer of bone of considerable thickness on both sides, with a soft mass of marrow-like tissue between.

This first bone is not hard like that of an adult, but more fibrous and spongy. Children frequently break their long bones, producing what is termed a "green stick" fracture, a rather troublesome sort of fracture to straighten.—*P. M. Club.*

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### Can Life Originate without Parent Forms?

BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

The revivification or renewal of life (restoration of life according to Webster) in certain organisms is problematical. That is to say, it is doubtful if life can be given again to dead organisms. But new life is possible as spontaneous generationists know. I was reminded of this on reading a remark on the revivification of *Rotifera vulgaris* by Dr. Joseph Leidy (*Proc. Acad. Sci., Phila.* 1874. p. 88). He says he noticed that during a search for Rhizopods, the water in which many of the common wheel animalcules, *Rotifera vulgaris*, lived could be dried up, and if again supplied to them the majority of them could again swell out and become as lively as ever. This was done with slides placed on the window lodge at a tem-

perature of of 80° F. Some absorbed new water and swam about, some did not. He says that he "next prepared a slide on which were upwards of twenty actively moving Rotifers, and exposed it to the hot sun during the afternoon. On examination of the slide, the following morning, after moistening the material, all the Rotifers continued motionless, and remained so to the last moment. From these observations it would appear that the Rotifers and their associates become inactive in comparatively dry positions and may be revived by supplying them with more moisture, but when the animals are completely dried they are incapable of being revived. Moisture adheres tenaciously to earth, and Rotifers may rest in the earth like the *Lepidosiren*, until returning waters restore them to activity; that is to say; the Rotifers can be dried up and revived but cannot be born again.

The animal does not exist, neither does the vegetable, but the organism does. It lives, reproduces and dies, to make place for another. Rotifers are masses of protoplasm that when dried at a moderate heat do not lose all of the water that is in their tissues. They can be awakened by supplying them with enough water to swim in. That it is the same with Bacillariaceæ I have many times seen. They can be dried up and do not lose all of their water. Salt-water forms as well as fresh water ones dry up but retain enough water to live by. It may be seen in the endochrome which is not quite gone. But when this is gone and the Bacillarians, *Navicula viridis* for instance in fresh water, and *Navicula perigrina* in brackish water, are white and lose all of their color they are dead and cannot be revived.

Can any organism be born again without the meditation of parents? I believe they can, and that spontaneous generation comes into play in the Protista and some of the so-called lower forms of living plants and animals.

### EDITORIAL.

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**Proceedings of the A. M. Society.**—We are today (Mar. 18) in receipt of "Part I, October, 1894," of this publication which the cover-page informs us is "Issued Quarterly" and by virtue of which it is transmitted through the mails as second-class matter. It contains pages 1-67 and 8 plates, price 50 cents.

From it we get the first official echo of the Brooklyn meeting held last August. If it takes seven months to issue part I, when may we expect parts II, III, IV? The contents of this brochure are as follows:

Pages 1-17, the Secretary's minutes of the sessions.

Page 18, the Treasurer's report for 1893-'94.

Pages 19-64, Kingsbury's paper on the Histology of the enteron of *N. maculatus*. (This is the paper of which we published a synopsis last November, pp. 339-345).

Pages 65-67, Miss Claypole's method for securing paraffin sections. (We reprint this in full under our head of Methods, pages 119-122.)

As these two papers and the Treasurer's report were read at the meeting, we infer that the principal cause of seven months' delay was the writing out of the Secretary's notes. And yet any competent secretary ought to be able to do this in from 7 to 17 hours. These notes are padded with six pages regarding a new form of microscope and regarding bacteriological work in the Hoagland Laboratory—matter entirely out of place in the minutes of the meeting. Both items would more properly appear as short papers by the respective authors.

On the first page, Dr. Lester A. Curtis gets the following compliment: "It is usual for the volume to begin with the annual address of the President, but the Secretary has never received it although he has written repeatedly to the President for it."

It will be remembered that the meeting was to begin on Monday morning, August 13, and that the President did not arrive until Tuesday morning. The evening of the first day is the proper time for the delivery of the Address, which once was an occasion of some importance. We have searched these minutes in vain to learn whether or not Dr. Curtis delivered any address at all! Evidently he did not, but that the Secretary tried to get a posthumous address out of him and failed—failing he ut-

ters the above-quoted howl. Had the ms. been forthcoming, the Secretary would have published it, and the world would innocently have supposed that Dr. Curtis delivered it. This reminds us of the way newspaper reporters write up events that do not occur. Is it quite scientific?

But how came this Dr. Curtis, of whom we confess never to have heard, to be President of this great American institution? What has he done in the realm of microscopy that entitled him to this distinction, for be it remembered that the fact of being President of the American Society has heretofore insured the incumbent an honorable election to membership in the Royal Microscopical Society of England. The only answer we can find is on page 9 of the brochure before us, as follows:

"The report of the Executive Committee with respect to the prizes which the Society was enabled to offer by the liberality of its president, Dr. Lester A. Curtis was then read."

These prizes, amounting to \$125, were provided for in August, 1893, at which time Dr. Curtis was elected President. It is fair to say that but for the prize papers of Wiegand, Kingsbury, Krauss, and Miss Claypole, one of which constitutes more than two-thirds of this brochure, there would not have been a reasonable excuse for continuing the "Proceedings" this year. But is it, in view of the outcome, too much, to guess that the little coterie of members at Madison, in 1893, unwittingly sold out the Presidency for \$125? Will the Royal Microscopical Society sell a membership for that consideration and not get the money either? We shall be interested to see the outcome. If any of the gentlemen who at Madison elected Dr. Curtis and accepted his prize-money wish to explain this transaction, these columns will be at their service in which to do so. We would not for a moment do him any injustice.

But about these prizes. Wiegand, Kingsbury and Miss Claypole, if we mistake not, were all students at Ithaca. Kingsbury says that his prize-paper did double duty, having been "presented to the Faculty of Cornell University for the degree of M. S. in June, 1894," in the preparation of which he says he was assisted by "the suggestions and advice of Prof. Gage throughout this investigation." The University gave him M. S. and the society gave him \$50 of Dr. Curtis' contribution. The three Ithaca students got \$110 out of the \$125. There were but three



of the unsuccessful competitors, and whether they were Ithaca students or not we do not know.

If these prizes were offered for investigations to be made "under the suggestions and advice" of college professors, then we congratulate Professor Gage upon his connection therewith; but we ask why in the world did not the Secretary see to it that all the Colleges had the knowledge which should enable them to enter the contest? If Dr. Curtis wanted to see his prizes fairly competed for why did he not insure an effort for them in some of the other 150 American colleges? Again we offer these columns to the Secretary and to Dr. Curtis in which to explain what safeguards they established to prove this a full, fair, open contest.

As this Journal goes into over a hundred colleges, we ask the subscribers in each one to report whether or not they had full and fair warning that their students might compete for these prizes and be assisted "by the suggestions and advice" of their professors. We offer to publish every affirmative reply.

In another column will be found the Announcement in full for the 1895 meeting. As will appear from the foregoing, the Society has more to expect from Ithaca than from any other quarter. The selection is wise. It would have been infinite folly to have followed the A. A. A. S. to Springfield, Mass., for there is not to our knowledge a microscopist in that city. The Ithaca people seem determined to have a good meeting next August. We shall keep you posted upon the outlook each month. In order that there be no trouble about the Secretary having Professor Gage's Address, we request that he send it to us in advance of the meeting. We will have it all in type and ready to distribute in our August number the moment he has finished reading it.

But how about prizes this year? Give us the facts, please.

## **MICROSCOPICAL MANIPULATION.**

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**A New Method For Securing Paraffin Sections To The Slide or Cover-Glass.**—Among the many steps to be taken in making microscopical preparations, that of securing the sections to the slide may seem of minor importance, yet the possibility of ultimate, successful results depends largely on the complete reliance to be placed upon the process by which this

step is accomplished. Especially is this true of serial sectioning when the disarrangement of the sections renders the slide almost worthless. In Lee's compilation of microscopical methods, "The Microtometist's Vade-Mecum," there are about a dozen different processes given for fixing paraffin sections to the slide. These processes fall into two natural divisions, those fitted for material stained *in toto* and those fitted for sections to be stained on the slide. Of those belonging to the second group, only a few admit of the use of both watery and alcoholic stains, and in most of them heat is an essential part of the process.

Many of the methods involve a previous coating of the slide with a substance that has to dry and be again moistened before the sections can be arranged upon it, such as collodion, shellac, or a gum-preparation. Some are useful for temporary slides, while in others the intricacy of the process greatly increases the chance of error, and adds to the time required for the work.

There are no methods given in Lee's work of an earlier date than 1880. One of the oldest is the Shellac Method, now no longer used. Schallibaum's collodion also is best fitted for bulk-stained objects. A slide is coated with a thin, even layer of one part of collodion to three or four volumes of clove or lavender oil. The sections are arranged and the slides heated over a water bath for five to ten minutes, or over a lamp for a shorter time, till the oil has evaporated. Gage and Summers use a pure collodion coat on the slide which is rendered adhesive by clove oil or ether-alcohol. There are many gum methods, but some forbid the use of watery fluids, and others are not fitted for alkaline stains.

Lee recommends Mayer's albumen for use with sections that have to be stained on the slide, and says that he has found it to be absolutely reliable. There is no need to describe so well-known a method, the principle is the coagulation of a thin layer of albumen by the use of heat. It is just at this point that the element of uncertainty comes into the process; much heat will injure the tissue, and in avoiding this danger there is a great probability of applying too little heat to coagulate the albumen.

Among other methods given by Lee is one recommended by Strasser, (*Zeit. f. wiss. Mikr.*, IV. 1. 1887, p. 45). It consists of coating the slides thinly and evenly with a mixture of two

parts of collodion with one of castor oil—the per cent of the collodion is not given. Sections are arranged on those prepared slides and coated with a thicker solution, —collodion concentratum duplex 2.3 parts, castor oil 2 parts; no warming is required, but the slide is put direct into a bath of turpentine for 2 to 10 hours to dissolve out the paraffin.

While working during the past year with serial sections, great trouble was experienced with Mayer's albumen method, and after some experimentation, the following plan was adopted: A layer of Mayer's albumen was spread on the slide and the sections arranged. Then a wash  $\frac{3}{4}$  per cent collodion was spread over the surface evenly with a camel's hair brush.

This is allowed to dry, which takes place in about one minute, but a longer time does no harm; practically, one slide dries while the next is being prepared. During the drying many small air bubbles appear, the presence of which indicates the right degree of dryness; these do not cause any inconvenience, as they disappear during the subsequent processes.

When dry the slide is put up, *without heating*, into a jar of xylol or benzin for half an hour or more, to dissolve the paraffin. A stay of several hours in the liquid will not injure the tissue. The paraffin may be removed in 3 to 5 minutes by constantly moving the slide in the benzin. The benzin or xylol is removed by 95 per cent. alcohol, and the sections are then stained and mounted as desired.

It was found best to have the liquid for removing the paraffin as fresh as possible, or else the thin film of collodion retained a sufficient amount of it to render the surface greasy; benzin was tried and proved in every way to be as satisfactory as xylol. Owing to its cheapness it is possible to use benzin in much larger quantities than xylol, and the requisite degree of freshness is easily obtained.

Many slides were prepared without the preliminary coating with albumen, and in all cases the collodion coat was sufficient to keep the sections fastened to the slide, but owing to the well known uncertainty in making a film of collodion adhere to glass, the albumen was used as a safeguard against failure, the alcohol in the collodion serving to coagulate the albumen. Different per cent solutions of collodion were tried and mixtures varying in the proportions of ether and alcohol. No difference

was found in the results given by the various mixtures but the per cent solution was the most satisfactory.

The chief advantage of this method is that it dispenses with the need for an alcohol lamp; an important and, in the hands of the inexperienced, a somewhat dangerous adjunct of the laboratory is thus removed from constant use. The greatest disadvantage is that, as in all collodion methods, the collodion is liable to take the stain and refuse to give up the color to treatment. Practically, however, in using the ordinary hematoxylin, eosin, picric alcohol, etc., there is no difficulty; it is only with the stronger stains that trouble is found. The use of this thin coat of collodion is a simple and effective method for general histological purposes.

**Preparing Fresh-water Algæ.**—M. F. Pfeiffer has published quite recently in the "Jahrbucher fur wissenschaft. Botanik (Bd XXVI, Heft IV) a recapitulation of the technical preparation of fresh-water Algæ. This work is divided in two parts; the first includes a description of the various reactive instruments, colouring matters, preservative liquids, stones of inclusion, fastening of the preparations. The second part is practical.

It consists of a great number of lists divided into five columns. In the first one the name of the Alga is to be found, the second gives the means of fixation. A third column indicates preservative liquids to use. The following column furnishes us the coloring liquids. Then the last contains the inclusions, to employ.

The author passes thus in review the following Algæ: *Batrachospermum*, *Hydrurus*, *Coleochaete*, *Bulbochaete*, *Oedogonium*, *Prasiola*, *Hormiscia*, *Chaetophora*, *Draparnaldia*, *Stigeoclonium*, *Conferva*, *Microspora*, *Trentepohlia*, *Microthamnion*, *Cladophora*, *Vaucheria*, *Volvox*, *Pandorina*, *Scenedesmus*, *Pediastrum*, *Sorastrum*, *Coelastrum*, *Ophiocytium*, *Raphidium*, *Tetraedron*, *Eremosphaera*, *Tetraspora*, *Dictyosphaerium*, *Nephrocytium*, *Gloeocystis*, *Botryococcus*, *Palmella*, *Pleurococcus*, *Protococcus*, *Euglena*, *Mesocarpus*, *Mougeotia*, *Zygnema*, *Spirogyra*, *Desmidiium*, *Hyalotheca*, *Sphaerzosma*, *Gymnozyga*, *Spirotaenia*, *Closterium*, *Penium*, *Tetmemorus*, *Disphinctium*, *Pleurotaeniopsis*, *Xanthidium*, *Cosmarium*, *Arthrodesmus*, *Euastrum*, *Micrasterias*, *Staurostrum*.

As can be seen from this long list, M. Pfeiffer has gathered in

his work some records on the preparation of all the groups of fresh-water Algæ. This technical review will therefore be of the greatest utility to all those who occupy themselves with Algology. We can assure them that the methods indicated by the author are excellent and that the preparations obtained in following them are irreproachable. We have had occasion to admire several of them.

The lists, especially, ought to be found on the desk of every algologist.—*Translated from "Societe Belge de Microscopie" by Rene Samson.*

**Off-hand Staining.**—Vegetable sections may be almost instantly double-stained by pouring into a watch glass, placed for easy inspection on a sheet of white paper, about half a teaspoonful of ammonia-carmin solution and stirring in a drop or less of aniline green solution which has been taken up on the blade used for lifting sections. Both solutions should be of a strength suitable for single staining, and the mixture may be tested by touching a piece of white blotting paper with the wet tool, which should produce a broad red stain with a minute nucleus of bright green in the center. The accidental production of such a spot, years ago, suggested to me the use of the solutions mixed, instead of separately in succession, as formerly done. A section dipped in this solution will be sufficiently stained in a few seconds, the different tissues taking the different colors very distinctly. Then remove the specimen and, without putting it in water, draw off the excess of staining fluid with blotting paper, then float and dabble quickly in alcohol and draw off excess, float in clove oil and mount in balsam or dammar. Unbleached sections may be used if not too opaque, but the most brilliant effects are gained after bleaching.—F. RITCHIE in *P. M. Club*.

**Sections of the Cerebellum** are unexcelled in beauty if stained as follows: 1. Harden small pieces in Miller's fluid for six to eight weeks. 2. Transfer directly to alcohol without rinsing in water. 3. Imbed in celloidin and cut sections. 4. Stain these for twenty-four hours in hematoxylin 1 pt., alcohol 10 pts., water 90 pts. 5. Rinse in water and bleach in borax 2 pts., water 100 pts., from one-half hour to several hours, until the gray substance is yellowish, the white substance remaining black. 6. Wash in water, pass through alcohol, clarify in xylol, or clove oil, and mount in balsam. The most beautiful and

marked differentiation of the tissue results. The cells of Perkinje can be beautifully traced to the very termination of their branches, and a complete and striking network of nerve fibres is seen, which will not tire the eye to study.—F. A. ROGERS.

**Mounting Cyclops quadricornis.**—Place them alive in water in a proper ring and put on a cover glass. Then have ready a mixture of equal parts of lime-water and glycerine. Soak out the native water at one end with blotting paper and let the lime-glycerine water run in at the other end until the cell is full of the mixture. Then cautiously build up an outer ring, putting a little and setting away to dry, then another and another. The cyclops is composed of carbonate of lime, and glycerine will entirely destroy it; but lime water added will counteract this destructive effect. A proper cell is of white zinc, old and hard, a year old preferred. This method will show the egg sacs and the four horns (*quadricornis*) naturally *in situ*, and the red eye in all its original splendor; and the mount will be a beauty and a joy forever. These mounts may keep perfectly for ten years or even longer.

These animals may be stained in picocarmine, and by careful treatment mounted in glycerine or dammar, which shows the internal structure also.—*P. M. Club.*

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## MICROSCOPICAL APPARATUS.

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**Second Hand Instruments.**—Mr. Clarkson, Bartlett's Buildings, Holborn, London, deals in all kinds of used optical instruments.

In reference to a railroad microscope stage adjustment as recently brought forth in England (Microscope Dec. 1894, p. 180.) it may be said that I own a B stand of Tolles made about 1874 in which the stage is moved by friction rollers—that in 1890 said stage was exhibited to Hartnach at Berlin and in 1887 in London to Mr. Lealand of Powell and Lealand—It is American. N. Y. 1895, Jan. 31—E. Cutter.

At the College of Physicians and Surgeons, Boston, there were shown some fine micro-photos of diseased blood taken in London with lime light eye-piece and objective by Dr. Keightley of London.

**Making a microscope.**—By applying the condensing lens under the stage-plate, does it do away with the diaphragm that is under the stage?

*Ans.*—The diaphragm should be used underneath the condenser of a microscope, to stop down and moderate the light to view the object to its best advantage. A condensing lens, non-achromatic, should be about  $\frac{1}{4}$  in. or  $\frac{1}{2}$  in. focus, as large in diameter as obtainable. Cost, about 2s. 6d. Obtain Hogg's book on the microscope, which gives full information on all accessory apparatus; the book is published at 7s. 6d.—*Work.*

**Loop Stage Clamps or Piano Forte Wire.**—That fine mechanic Albert Storer of Boston has fitted the Shurtleff stage of the Clinical microscope with a loop of piano forte wire. The free ends of the loop are bent at right angles and fit into holes bored in the stage on its under side near the front. Thence they run backwards to the rear of stage and the loop is bent forwards to the front of stage. This arrangement securely holds the slide while from its toughness and form it is not readily detached, but is flexible, elastic and satisfactory. They can be used on other stages. When it is remembered that the principle of the loop is a fine one as it has strength, utility, and durability it closely applies force to whatever object applied. Surgery has benefited and now microscopy benefits from the loop.

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## MEDICAL MICROSCOPY.

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**Dr. O. W. Holmes as a Microscopist.**—Said he "It is curious how the novice always sees air bubbles under the microscope. Put the nicest object you may in the field and the novice will first ask about the air bubbles that may chance to be there." Forty-two years of micrographic experience confirms this dictum: It might be classed as an *innate idea* in microscopy.

Dr. Holmes in 1853 used a microscope made by Spencer of Canastota, N. Y., which belonged to the late Dr. Waldo T. Burnett of Boston, Fellow of the American Academy, whose early death, 1854, was greatly mourned. Dr. Holmes said that Dr. Burnett had taken this microscope to Europe and had there resolved diatoms that were unresolvable there before. So Amer-

ican microscopes made a *good European showing* before 1850. Some twenty years ago Dr. Holmes selected for a gentleman of Sacramento, Cal., two very fine Tolles's objectives which he made a present of to Dr. G. L. Simmons of that city. He says that the objectives were in his office when a Chinaman came for consultation, as usual accompanied by other Chinamen, as friends—that while he attended to his patient the others stole them—that a police investigation revealed that the objectives were thrown into Sacramento river-bed mud and the brass boxes were used to keep opium in for smoking. Sad fate for such nice instruments that were selected by so honorable a microscopist. Surgeon General A. C. Page of Truro, N. S., Government Inspector of Hospitals and Asylums for Nova Scotia, was a student in 1854 and 1855 of Dr. Holmes and well remembers the brilliant demonstrations then made.

**Encouraging Microscopical Science.**—The Vermont Microscopical Association has just announced that a prize of \$250, given by the Wells & Richardson Company, the well-known chemists, will be paid to the first discoverer of a new disease germ. The wonderful discovery by Professor Koch of the comma bacillus, as the cause of cholera, stimulated great research throughout the world and it is believed this liberal prize, offered by a house of such standing, will greatly assist in the detection of micro-organisms that are the direct cause of many diseases. Any information upon this subject will be cheerfully furnished by C. Smith Boyton, M. D., secretary of the association, Burlington, Vermont.

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## DIATOMS.

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**What Are Diatoms?**—The plants in question are so small as to be seen only with the aid of the microscope; those of ordinary size, when magnified about three hundred and fifty diameters, appear about a quarter of an inch long. Others are much larger. They are curious little plants with a silica shell, which in certain places, is provided with little apertures through which living parts of the plant protrude. In this way they are enabled to move about freely in the water by which they are generally surrounded, for, though they are strictly



water plants, they all need considerable water to enable them to thrive, and so are always found in wet places.

Owing to their freedom of motion they were at one time supposed to be animals. Now it is known they are plants, as they can perform all the functions of plants, and no animal, with all his superiority, high nature, etc., is able to do this. They are found everywhere in all inhabited countries, and in fact all over the seas, so it may be readily granted that a plant so common and wide-spread as this should be quite familiar to every one.

Again, not only are the living plants so wide-spread and common, but the shells of the dead ones remain intact for many years; and in some localities these tiny shells are so numerous as to form a large portion of the soil. Some of the best known of these localities are the sites of Richmond, Virginia, and Berlin, in Germany.—EMILY L. GREGORY, in *The Popular Science Monthly*.

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#### NECROLOGY.

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**Rev. Samuel Lockwood, Ph. D.**—The frontispiece of our March number contained a portrait of Dr. Lockwood, through the kindness of Dr. Ward. He died at his home in Freehold, N. J., on January 9th, 1894, at the age of 75 years. Born in England and educated in New York, except for a theological course in New Brunswick, N. J., he spent the years from 1850 to 1869 in pastoral work in various churches. In 1867 he undertook the additional labor of Superintendent of Instruction for Monmouth County, N. J., a field for which his tastes and talents as an educator were so well adapted that three years later he removed to Freehold, N. J., and devoted the remainder of his long life to the work with an ability that gave him a national reputation. He became a biologist in the broadest sense, his great faculty for both study and teaching leading him out freely in different directions. Microscopy, however, was his favorite resource in every field. His valuable addresses and other works were an important element in the life of the New York Microscopical Society, and of the New Jersey State Microscopical Society, of which he was one of the founders and chief supporters, and of which the minutes, lately published,

constitute, perhaps, his best monument.—*Report of Postal Club.*

**E. J. Attinelli, M. D., Vineland, N. J.**—An American born son of an Italian patriot, he died Jan. 1, 1895. He naturally, after graduating in medicine and establishing himself in practice in New York City, maintained a successful practice and took a prominent position in the Italian departments of the medical charities of the city. During the last two or three years he resided in New Jersey. He was a patriotic citizen as well as an accomplished archæologist and microscopist. In the Club he was always prompt, careful and helpful, and his brief notes in the books showed a genial and thoughtful interest in the work of all —*R. P. C.*

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### NEW PUBLICATIONS.

*Hypnotism.* By James R. Cocke, M. D. 12°. pp. 373. Arena Pub. Co., Boston, Mass. 1894.

Dr. Cocke has hypnotised 1350 people and studied its power. He can induce a subject to stab him with a paper dagger but not with a knife. He can hypnotise the willing subject 60 times in 100, but he cannot hypnotise the averse subject. He agrees with Hudson that no one unless it be hardened criminals can in the hypnotic state be induced to commit crime. Having hypnotised himself, the resulting phenomena described are quite startling.

The means of distinguishing between a truly hypnotic condition and a feigned one are well described. The experiment of making one of a subject's hands warm and the other cold would seem conclusive evidence of the reality of the alleged phenomena,—enough to convince the most skeptical.

Dr. Cocke indicates in what class of diseases, hypnotic suggestion may be beneficial and what classes are beyond its reach. He recognizes dangers from the misapplication of hypnotism just as he recognizes the dangers from the improper use of drugs. Naturally, he wishes its use and that of drugs confined to his profession—a purely selfish consideration, we fear.

Dr. Cocke supplements his own knowledge by citing the opinions of others to a considerable extent. In conclusion he gives a list of 333 titles of publications relating to the subject, most of them being European.





**SIMON H. GAGE,**  
PRESIDENT, AMERICAN MICROSCOPICAL SOCIETY.

# THE AMERICAN

## MONTHLY

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### Pretuberculosis.

By EPHRAIM CUTTER, M. D., LL. D.

NEW YORK.

### MORPHOLOGY OF HEALTHY BLOOD.

To understand pretuberculosis,\* it should be said that healthy blood has certain form elements characteristic under the microscope and that persons apparently macroscopically healthy, sometimes present abnormal blood morphologies from latent or incubative diseases. Besides the detection of abnormal blood implies a knowledge of healthy blood. Briefly its morphology presents clinically—1. The red discs, clean cut, well outlined, plump; in and during death they arrange themselves in rouleaux, like coins, with curves of Hogarth's lines of beauty—or they are segregate, distinct, separate and quite uniformly arranged in the field.

2. *White corpuscles* or leucocytes are on the average one third larger in diameter than the red, sometimes globular or oval, sometimes still and sometimes mobile, sometimes dividing up into two, three, four, five or more regular or irregular parts and reuniting. Sometimes being merged into one with other leucocytes; sometimes

\*This article is abbreviated from an essay which Dr. Cutter wrote in 1877, in competition for the American Medical Association's prize. It was illustrated with 68 original microphotographs and written in the belief that 13,000 lives could be saved annually in the U. S., by the detection and treatment of the pretubercular stage alone. It is now 40 years since Dr. Jas. H. Salisbury, LL. D., discovered this physical sign and used it. Dr. Cutter terms it "the Morphology of Consumptive Blood." The paper was offered at the Brooklyn meeting of the A. M. S., and not read nor called for.

with weird, bizarre, awry and anfractuous, amoeboid shapes.

3. *Serum* is clear and free, as a rule with some exceptions, from any form elements save the fibrin filaments which are so exquisitely minute and subtile as to be clinically invisible.

#### MORPHOLOGY OF TUBERCULOUS BLOOD.

*Red discs.* Pale, ill-outlined, coloring matter not well held, sticky, adhesive, do not as a whole form in rouleaux nor settle into separate, segregate, distinct, uniform dispositions over the field. Clot into ridges, irregular winrows and huddled masses like frightened sheep; at times so adherent as to be drawn out in the death movements like molasses candy or into acute pointed ovals. They are generally lessened in number and often present themselves in half sizes which some term the "third corpuscles" of the blood. As nature cures tuberculosis, (and she does sometimes cure tuberculosis) there will be seen a turning towards the type of healthy blood even before the cavities are healed, and there will be seen attempts at rouleaux and segregation as in health.

2. *Leucocytes.*—Generally abnormally enlarged by entophytal growths, to varying sizes. One beautiful and useful test of the microscope as to treatment is the bringing the enlarged leucocytes down to nominal size. Amoeboid movements are not different from those in health. Tuberculosis is not the only enlarger of the leucocytes. Hence, this point must not be relied on alone.

3. (a) *Serum.* Fibrin filaments enlarged, massive, completely filling the serum interspaces between the red discs and leucocytes with a finely woven net-work of close acutely angled, irregular meshes. These strong fibrin filaments and close meshes cause the irregularities in the appearance of the red discs on the slide after their removal from the blood stream and their death.

3. (b) *Spores and Spore Collects*.—These are whitish globular or irregularly globular bodies varying in size but on an average of 1-12,000 inch in diameter that occur single, double, triple and so on to aggregations of hundreds and thousands into large oval masses, which by the action of the blood stream are rolled generally into flattened oval or bluntly fusiform bodies, looking like snow among the red discs. In bad cases these spore collects appear in amœba-like shapes almost filling the whole field!

These spores are still, non-mobile. They appear white like snow while in focus. Out of focus they are a light green grayish color. They are present in largest number immediately on their withdrawal from the blood stream and many of them disappear in the course of ten minutes. This speedy dispersion makes it necessary to have the patient and microscope present together and hence the usefulness of clinical microscopes furnished with the best objective and illumination by direct light. The writer uses a common candle. It has proved sufficient for the 1-50th inch objective of Tolles, 178° angular aperture. Those who have a draw tube with society screw, by the invention of Dr. Eugene Shurtleff of Boston, can use their own objectives as clinical microscopes at the cost of a few dollars. Mr. Albert Storer of Boston provides with the Shurtleff stage a loop clamp of piano forte wire which is the best thing I have seen for holding slides on a clinical stage.

There are other morphological elements in tuberculous blood, but for our purpose the above are sufficiently diagnostic in cases suspected of tuberculosis. The above vegetations in the blood of tuberculosis are, in the opinion of the discoverer and others, myself included, the mycoderma aceti or vinegar yeast in baby or micrococcus stage. The aerial mycelial adult forms do not grow in the blood.

## PRETUBERCULOSIS.

The idea that diseases have periods of incubation preceeding their full development accords with other facts in animal and plant-biology. It is to be expected that tuberculosis of the lungs for example has a pre-stage. In fact pretuberculosis exists and clinically means that the morphology of consumptive blood is present to a lesser extent than in tuberculosis, that the essence of pretuberculosis is in these vegetations in the blood, which coming from the fermentations in the alimentary canal, pass the barriers of the intestinal epithelia and float about in the blood stream of consumption *any time during one year before the necrosis or sphacelation or breaking down of the lungs, sufficient to be detected by the usual signs, furnished by auscultation and percussion.* It is evident that in such spongy bodies as the lungs small deposits may escape physical macroscopical exploration. But the microscope will detect this stage.

## STATEMENT AS TO SUBJECT.

When consumption or tuberculosis is suspected from bowel troubles, cough, loss of flesh and strength, pallor, weakness, short breath, loss of appetite, hemorrhage from the air passages, &c.; such a case is apt to be a puzzle to the diagnostician, from absence of positive physical signs of lung lesion. For it may or may not be consumption and the usual plan is to watch and wait till lung lesions are manifested. In other words the case is in the dim border land which interdigitates between health and disease. The line of demarcation between health and disease is not always clear. Such cases of consumption are a great trouble to physicians and patients. I know this from subjective experience, for the late Dr. H. I. Bowditch once explored my thorax after I had expectorated blood and cretaceous tubercles



(as thought, though they were only "lung gravel stones") and when I had cough (depending mainly on the irritation of lung gravel,) some emaciation, pallor, and other rational signs of tuberculosis. I insisted that he should tell me as to tuberculosis. He would not and could not. Dr. John A. Lamson of Boston, my medical classmate, Harvard, 1856, also explored my chest with like results of "not proven" and doubtful. But Dr. Salisbury at once showed by the morphology of the blood that the disease was not tuberculosis. The 23 years since lapsed prove this diagnosis true. This is what I have termed the *negative diagnosis* of tuberculosis.

#### POSITIVE DIAGNOSIS OF PRETUBERCULOSIS.

In a certain number of the aforesaid doubtful cases, the morphology of consumptive blood is found showing that pretuberculosis exists. In pretuberculosis there is and has been a consensus of opinion, medical and lay, that consumption is more tractable and curable (if at all) because there is no detectible lung lesion. I reported such cases to the Berlin International Medical Congress, 1890. Some of them date back as far as 1876-7, are living today, thus more than ten years cured.

#### METHODS.

The process used is a modification of that adopted, intelligently described and published by Surg. J. J. Woodward, U. S. A., who is the father of modern micro-photography and to whom the writer would here express his sincere thanks for advice and encouragement.

The modification is slight and includes portability. The apparatus is packed in a large box ready for use and transported to any point desired. It differs also in the use of only one condenser instead of two as in Woodward's apparatus. It excludes the blue colored cell of glass or of ammonia sulphate of copper. (1876). It includes the use of objectives the highest in power ever made, namely, the 1-50 and 1-75th inch objectives. The highest one he had employed at last accounts, was a 1-18th in-

The performances of these high powers speak for themselves. The 1-75th was never before used in micro-phógraphy of any kind before the writer and Dr. Harriman, used them. Still the 1-10th inch 4 system objective answers for ordinary purposes.

Even the  $\frac{1}{4}$  2d class Tolles objective performed well. So that those having low power objectives should try to use them thus. The modifications of the Woodward process do not detract from their high value and reputation.

It was the writer's aim to have an apparatus which might be exhibited in practical operation to societies of medical gentlemen at their places of meeting. This aim has been realized in a measure.

The procedures employed in taking the photic illustrations required :

1. The patient to be present.
2. The operator and assistants.
3. The camera.
4. Sun Light.
5. Microscope.
6. Condenser.
7. Mirror or Heliostat.

**1. The Patient to be Present.**—Generally it was necessary to have the patient present because it was found that taking the blood from the patient and carrying it a mile or two to the photographer's saloon, caused the appearances to lose their distinct, well marked characters. The sooner the pictures are taken the better the result. This element of the patient's presence was one great difficulty in the way. It was found, at first, no easy matter to have the patient and the other requisites all make a conjunction together of time and place. Most of the illustrations were taken at Tewksbury (Mass.) State Alms-house and also at the U. S. Naval Hospital, Chelsea, Mass.

**2. The Operator.**—To do this work assistance was found necessary. This the writer received from G. B. Harriman, D. D. S., of Boston, who attended to the adjustment of the light, microscope and slides. The high power objectives used were (1877,) his property, the writer selected and collected the specimens, watched the camera plate and focussed some of them. J. W. Black & Co., Boston, furnished the dark room man ; a professional in every case. This was Woodward's recommenda-

tion. It is doubly right. The "man" sensitizes these plates (wet,) introduces them into the camera, uses his judgment as to exposure, prints and mounts the negatives. The toning forcing and developing these photos are a nice work of skilled professional labor. A non professional may do it. Of course the writer overlooked the professional and exercised his judgment as to development, toning, forcing, printing and mounting. It was found that three persons were fully and thoroughly occupied while the work was going on.

**3. The Camera.**—Common  $\frac{1}{4}$  and  $\frac{1}{2}$  plate cameras were used. The photographic objective was removed from the camera which was mounted upon a base board. This board was made of black walnut thoroughly filled with varnish and polished according to the arts of piano case finishing.

Its dimensions were : 55 inches in length, 11 inches in breadth,  $1\frac{1}{2}$  inches in thickness. In the longitudinal center tin strips of brass polished, (One inch wide,  $\frac{1}{8}$  inch thick, 55 inches long) were inlaid in such a manner that a slot  $\frac{1}{4}$  inch wide was left between them. The wood of the board underneath the slot was grooved out  $\frac{3}{4}$  inch wide, and  $\frac{1}{2}$  inch deep and 55 inches long. This arrangement gave an exact longitudinal center on which the camera, the condensor, and the microscope are fastened and mounted by strips of ebony  $\frac{1}{4}$  inch wide that run smoothly in the brass slots attached to the basis of the apparatus named. This device holds them in the median line. To keep them from lifting out—strips of brass  $\frac{1}{2}$  inch wide and 2 inches long were attached to the ebony strips so that when placed their upper surface comes in contact with the under surface of the 55 inch brass strips. Thus the parts can be shifted backwards and forwards without deviating from the median line.

The camera was set upon a box 11x8x4 inches, attached to the base board of camera by brass slots and T strips. This elevation was necessary in order to bring the center of the camera up to the center of microscope.

**4. Sun Light.**—This was employed because when available according to Woodward it is the best light for microscopy. It is an annoying light because so often absent and interfered with by clouds, haze, buildings and trees. It requires patience,

as often it fails just at the very instant it is most needed. Only a few days of this light were available for the nicest photos. They come usually after a long storm to thoroughly clear the atmosphere. The haze of other apparently clear days shows on the positive plate. I learned how to determine the presence of this haze by unaided ocular observation. Probably California is the best place for sun light.

**5. Microscope Stands.**—The following were used :

(a) Tolles B. stand with first class stage R. R. friction movement and with a draw tube expressly made by Mr. Tolles for this use.

(b) Tolles student stand.

(c) Tolles clinical stand.

(d) Tolles objectives.

1. 2d class  $\frac{1}{4}$  inch.
2. 4 system 1st class, 1-10th inch.
3. 3 " " " 1-16th inch.
4. 3 " " " 1-50th inch.
5. 4 " " " 1-75th inch.

No oculars were employed.

When the B. stand was used it was placed directly on the base board in the center. The tube was placed in a horizontal position. The draw tube was removed and the open end of the special draw tube projected into the empty nose of the camera. By winding a common black shawl about them, extraneous light was cut off. The same shawl answered for a veil over the observer's head while he was looking at the picture upon the ground glass plate.

The student's stand was mounted on a base fastened yet movable, as has been described and used the same as the B. stand.

**The Clinical Stand** was used by having black walnut 10 x5x1 mounted on a small base, which in its turn was fastened to and movable in the 55 inch groove. A hole of the exact size of the microscope tube was bored squarely through the upper end of this block exactly in the line of the 55 inch furrow and opposite the center of the cameral aperture. When the clinical tube was introduced in the right direction it was ready for use with the aid of the black shawl above referred to. All the objectives named were used with this clinical stand as it was found

to be the most easily managed of the three. Only American microscopes were used.

**Focussing Apparatus.**—On the right side of the camera two screw eyes are inserted into the base board about 3 feet apart. A hard wood rod 3-4 inch in diameter fits into the space between and is held by two screws passing through the eyes into both ends of the rod. A milled head is attached to the screw at the proximal end of the rod. Two feet of the distal end of the rod are covered with glue and sand dried together. A band of tape goes around the rod and the fine adjustment of the microscope. This afforded a good working adjusting apparatus for focus—much better than an assistant working by calls.

**6. Condenser** used was a Voigtlander photographic objective:  $3\frac{3}{4}$  inches in diameter and 8 inches long. It is a decidedly first class instrument and in the writer's opinion much of the success obtained was due to this particular instrument. It is costly and valuable (\$300)—loaned by Mr. F. W. Hardy A. B., of Bangor, Me. (now of Springfield, Mass.) Compared with other lenses in a large city photographic gallery it excelled them all.

**7. Mirror.**—This was made of heavy plate glass 8x8 inches square mounted so as to whirl in two opposite directions.

**8. A Heliostat** of simple construction is combined with the apparatus. It has one motion only.

For use the mirror must be placed towards the north pole and the heliostat mirror in a plane below.

#### TIME OF EXPOSURE OF SENSITIVE PLATE.

One and a half seconds to ten seconds. A piece of black card board 4x10 inches was held in the hand, removed and replaced in the line of light next the slide by the operator or assistant. The length of time of exposure varies with the sun-light and time of day. It is best to time by the action of the proto-sulphate of iron on the exposed plate. This is a point for the dark room man's judgment. This description being historical and not dogmatic, only includes the simplest processes which were thought to be the best for the present purpose. They will probably be supplanted by simpler ones in contemplation.

#### LIST OF MICRO-PHOTOS.

1. Blood of consumptive—human, 3d stage. Wet, 1-16th inch objective

450x. Shows Fibrin filaments, spores, spore masses, white corpuscles enlarged, amoeboid movements.

2. Blood, consumptive, 3d stage; dry, 1-50th inch objective, 1300x. Shows white corpuscle enlarged with internal changes from ento-phytal growths. Red corpuscles thin, pale, nucleated.

3. Healthy human blood; dry, 1-50th inch, 1800x. White corpuscle shows clear face and no ento-phytal growths. Clean serum interspaces. Red globules.

4. Consumptive blood, 2d stage; dry, 1-16th inch, 450x. After three months of animal food diet, shows when compared with 5, a clearing up of spores—nummulation attempted, white corpuscles mostly reduced to normal size. Spore collects, much minished, serum interspaces, much cleared up.

5. Consumptive blood, 2d stage before treatment by animal food diet; dry, 1-16th inch, 500x. Shows red blood muddled and confused. Interspaces crowded with spores, larger spore collects larger white corpuscles than in 4.

6. Human blood, consumptive, 3d stage; dry, 1-50th inch, 2,000x. Shows three white corpuscles enlarged with ento-phytal growths. Where a mass of broken substance appears are the remains of a fourth white corpuscle that ruptured by the sun's heat in the act of taking.

7. Same as preceding, but taken with a higher power, namely, the 1-75th inch, 3,000x. The first ever taken with this objective; 1876.

8. Human blood consumptive, 3d stage; dry, 1-16th inch, 450x. Fibrin filaments and spores.

9. Ditto—3d stage, 1-16th inch, 450x. Wet, but dried by keeping. Vacuoles or gas bubbles traversed by beaded filaments and dotted with spores. On very close examination the main field is seen to be occupied by red globules faintly outlined in the serum; by white spores near the center is a black straight submerged mycelial filament probably a syphilitic complication.

10. Consumptive blood—advanced stages. 1-10th, 4 system, 180° ang. aperture. Massed red globules; Fibrin filaments, spores.

11. Ditto, 1-50th inch, 1,450x. Roleaux attempted. Fibrin filaments. Large mass of spores of vinegar yeast or mycoderma aceti.

12. Ditto, 1-10th inch, 450x. Spores in and about the red globules.

13. Ditto. Enlarged white corpuscles.

14. Ditto. Spores.

15. Ditto, 1-10th inch. Foreign substance, probably a hair soaked in sweat. Enlarged white corpuscle. Attempts at nummulation, spores.

16. Ditto, spores, spore collects. Fibrin filaments, enlarged white corpuscles.

17. 1-10th inch. Soap; showing filaments that might be taken for mycelia. A comparative study suggested by a doubter.

18. Fibrin filaments in consumptive blood; spore well brought out. Mass opposite the three red corpuscles is foreign. Some would call the small red corpuscle, the third corpuscle. We regard it as an imperfectly developed red disc. 1-50th inch.

19. Consumptive blood,  $\frac{1}{4}$  inch, 200x. Vacuoles or gas bubbles; spores.

A long, massive fibrin filament such as seen in embolism. This is a complication element.

20. Consumptive and Rheumatic blood,  $\frac{1}{4}$  inch, 200x. Massive embolic filament outside and filaments inside the vacuoles or gas bubbles. Kept specimen.

21. Ditto,  $\frac{1}{4}$  inch, 200x. Fibrin filaments. Fat or soap (?) massive filament; spores. Note the red discs drawn into pointed double-enders by the fibrin filaments in dying.

22. Syphilitic blood, 1-10th inch. For comparison. Free oily, fat globules from beneath the skin—an early sign of fatty ill, spores hazy because auto-mobile.

23. Another case like 19.  $\frac{1}{4}$  inch.

24. Syphilitic and consumptive blood;  $\frac{1}{4}$  inch. Mycelium of crypta syphilitica; spores of tuberculosis.

25. Better print of 19.

26-30. Syphilitic blood for contrast;  $\frac{1}{4}$  and 1-10th inch. The comparison of the photos of the  $\frac{1}{4}$  inch and of the highest powers, favors the latter.

31. Consumptive blood; 1-50th inch. Faintly shows fibrin filaments. Spores.

32. Ditto; 1-75th inch. Enlarged white corpuscle with spores inside and out.

33. Ditto; 1-10th inch. Spores and spore collects. Vacuole or gas bubbles. Below it a gravelly matter, foreign.

34. Ditto; 1-10th inch. Large air bubbles or vacuoles, fibrin filaments. Spores.

35. Ditto. Red corpuscles pale and ill outlined; spores and collects abundant.

36. Consumptive syphilitic blood; 1-10th inch objective. Two white corpuscles enormously enlarged. Spores.

37. Consumptive blood; 1-10th. Spores and spore collects of mycoderma aceti.

38. Ditto; 1-10th, spores. Large vacuole or bubble. Red discs drawn out. White corpuscle.

39. Ditto. Bubbles or vacuoles. Three white corpuscles with amoeboid prolongations.

40. Ditto. Attempts at rouleaux. Several white corpuscles of varying sizes, single and double spores.

41. Ditto; 1-50th. Spore collect and spores.

42. Ditto; 1-10th. Fat globules in with the spores and collects.

43. Ditto. Fibrin filaments. Enlarged white corpuscles, spores. Dermal epithelia invaded with spores.

44. Do; 1-16th inch. Spores and red discs.

45. Do; 1-16th inch. A poor photo, but instructive. Spores and chains of spores.

46. Morphology of skin; scraping. Study of foreign substances sometimes found in the blood by accident.

47. Pretubercular blood in a suspicious case, 1-10th inch objective.
  48. Lard. A study, 1-10th inch. Stearine crystals.
  49. Morphology of skin of 47. Cotton fiber, dirt in, 1-10th inch.
  50. Morphology of air. Dust from top of office furniture, 1-10th inch.
  51. Morphology of skin of 47. A study, dermal epithelia and spores, 1-10th inch.
  52. Morphology of air. Office furniture, near room top. Shows the power of aerial flight residing in organic substances. A study.
  53. Morphology of food. Rancid butter. Shows butyric acid fermentation vegetation, mycelium. Study, 1-10th inch.
  54. Morphology of blood. Pretubercular, 1-10th inch.
  55. Morphology of blood. Mycelium of crypta syphilitica, 1-16th inch.
  56. Morphology of the blood of boils. A study. Quinia sulph. in a few days cleared the blood to normality, 1-16th inch. Otherwise uninteresting.
  57. Morphology of air. Studies. Sewer gas, vegetations, conidia two. Spores single, double, automobile, 1-50th inch.
  58. Morphology of foods. Lactic acid fermentation from sour kraut, 1-10th inch objective.
  59. Ditto. Yeast conidium active, with large vacuole. The large hazy spots are automobile spores, 1-50th inch.
  60. Ditto. Lactic acid vegetation, sour kraut, 1-50th inch.
  61. Ditto. Gaff & Fleischman's yeast; larger conidia than common, 1-50th inch.
  62. Morphology of air. 1-10th inch. Sewer gas vegetations.
  63. Morphology of foods. Yeast, rye starch grain, yeast conidium, bacteria and automobile spores, abundant, 1-50th.
  64. Ditto. Yeast 1-50th. Shows a fine bacillus probably tuberculous.
  65. Ditto. Yeast; 1-16th inch. Conidia.
  66. Ditto. Starch grain changing into  $\text{CO}_2$ , glucose and alcohol; 1-50th inch. Process that goes on in bread making.
  67. Ditto. 1-50th inch. Butyric acid fermentation vegetation. Mycelial filament terminating with conidium.
  68. Microphotoc apparatus of E. Cutter used with these original photos.
- 120 Broadway, August 1894.

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## Diatom Growths in Surface Waters.

BY GEORGE C. WHIPPLE,

BIOLOGIST OF THE BOSTON WATER WORKS.

(Abstract of a paper published in The Technology Quarterly, Vol. VII, No. 3, October 1894.)

For more than a century the study of the diatoms has been a fascinating pastime. Much has been written on the beauty of their form and markings, their animal or



vegetable nature, their classification, and their peculiar spontaneous movements. Their study is now becoming one of practical importance, because it has been found that these little plants are often present in large numbers in the ponds and reservoirs of our public water supplies, and that they cause unpleasant tastes and odors.

For several years it has been my pleasure to study the diatoms from this practical standpoint. My observations have been confined chiefly to the reservoirs of the Boston Water Supply and to some small ponds in the vicinity of Boston, but the published reports of the Mass. State Board of Health have given opportunity for comparison with the diatom growths in other localities.

Of the one hundred and more genera into which the diatoms have been classified there are not more than twenty that are commonly found in our water supplies, and only six have, thus far, been found to be of practical importance, namely, *Asterionella*, *Tabellaria*, *Melosira*, *Synedra*, *Stephanodiscus* and *Diatoma*. Some of the other genera met with are *Cyclotella*, *Cymbella*, *Epithemia*, *Fragilaria*, *Gomphonema*, *Meridion*, *Navicula*, *Nitzschia*, *Pleurosigma*, *Schizonema*, *Stauroneis* and *Surirella*.

The six most important genera are not always observed in the same reservoir. Usually there are certain diatoms peculiar to certain ponds. Lake Cochituate, for instance, often contains large growths of *Asterionella*, *Tabellaria*, and *Melosira*, and smaller growths of *Synedra* and *Stephanodiscus*. Basin No. 3 contains *Asterionella*, *Tabellaria*, *Synedra*, but no *Stephanodiscus* nor *Melosira*. In Basin No. 2 only *Synedra* and *Cyclotella* are found. Fresh Pond, Cambridge, is famous for its *Stephanodiscus*, and *Diatoma* is often very abundant in the Lynn waters. Furthermore, there are ponds where diatoms are never found, except in very small numbers at rare intervals, while in neighboring ponds they may

be present in such large numbers that a bottle of the water when held towards the light has a silvery, glistening appearance.

The *Asterionella* is usually the most troublesome of the diatoms. A comparatively small number, say 1000 per c. c., is often sufficient to impart a decidedly unpleasant taste to the water. This taste is a very characteristic one, a person soon becoming so familiar with it that the presence of *Asterionella* in a sample of water, when concentrated for examination according to the Sedgwick-Rafter method, may often be detected by tasting it. The taste is usually described as resembling the odor of a sweet geranium. At times it is decidedly oily.

*Tabellaria*, *Diatoma* and *Stephanodiscus* are also to be noted as taste producers. *Synedra* and *Melosira* usually give no trouble.

Diatoms usually flourish best in ponds having muddy bottoms. They are not found equally abundant at all seasons of the year, but their growth is confined chiefly to the spring and fall. There seems to be a considerable difference between the seasonal distribution of diatoms in deep and shallow ponds. In ponds more than about 30 feet deep there are usually two periods of maximum growth, one in the spring and one in the fall; while in ponds less than 30 feet deep the fall growth is usually slight or entirely absent. During the summer diatoms are absent from deep ponds, but in shallow ponds they sometimes attain a considerable growth.

The cause of this seasonal distribution is to be found in the "phenomena of stagnation and circulation."

It is well known that in ponds which are more than 25 or 30 feet deep the temperature of the water at the bottom remains quite constant during the summer, while the temperature of the surface water rises and falls with the temperature of the air. The consequence is that the

lower strata of water remains stagnant during the summer; that is to say, there are no vertical currents in the water below the depth where the wind ceases to keep the water in motion. In the fall the surface water cools until it reaches the same temperature as the water at the bottom. Then, when the density of the water is the same at all depths, there is a stirring up; the lower layers are brought to the surface, and the light, flocculent, amorphous matter, always abundant at the bottom when the soil is muddy, is distributed through the water. During the winter, when the surface of the water is frozen, there is another period of stagnation, due to the fact that the temperature of the water at the bottom tends to remain at the point of maximum density ( $392^{\circ}$  F.), while the surface temperature sinks nearly to the freezing point. The winter stagnation takes place in both deep and shallow ponds.

There are thus two periods of the year, one in the spring and one in the fall, each about six weeks long, when the water is in circulation from top to bottom. It is during these periods that the diatoms develop.

Study of the physical and chemical conditions of surface waters has shown that the two most important conditions for the growth of diatoms are a sufficient supply of nitrates and a free circulation of air, and that both these conditions are found at those periods of the year when the water is in circulation.

As to the effect of temperature on diatoms, our observations indicate that the variations of temperature usually met with in the ponds of this climate have comparatively little direct influence on their growth, certainly not enough to account for their seasonal distribution. Diatoms grow well both in summer and winter, provided food is plenty. Vigorous growths have been observed at temperatures ranging from  $35^{\circ}$  to  $75^{\circ}$  F.

The mean temperature at which the maximum *Asterionella* growths have been observed in Lake Cochituate is 50° F., the temperatures of the different growths, however, varying from 35° to 67°. The temperature of the water affects the diatoms indirectly by producing stagnation, as has already been pointed out.

The question of the rate of increase of diatoms is an important one. It has generally been assumed that the increase takes place in accordance with the law of geometrical progression, i. e., starting with a single cell, this cell after a certain time divides into two, each of which after another interval of time divides into two more, and so on, so that after  $n$  intervals of time, the number of cells would be  $ar^n$ , where  $a=1$ , and  $r=2$ .

There are some writers, following Otto Muller, who have claimed that the increase takes place more slowly than this, because, they say, when a cell divides, the smaller of the resulting cells does not have the same power of reproduction as the larger on account of lacking the necessary thickness of connective band.

My observations seem to show that the diatoms do increase substantially in accordance with the law of geometrical progression, and that the ratio varies between 1.3 and 2.0 per week, the average ratio for ten growths of *Asterionella* covering a period of thirty-five weeks being 1.58. The corresponding ratio for *Tabellaria* was 1.56. We may say, in a general way, that during a vigorous growth these diatoms increase at the rate of about 50 per cent each week.

A growth of *Synedra* in Basin No. 2 of the Boston Water Supply, lasting ten weeks, had a slower rate, the average ratio being 1.3 per week. In this growth the *Synedra* multiplied more rapidly at first than they did later on. The ratio for the first half was 1.4, and for the second half, 1.2.

But to say that the diatoms increase slowly and regularly does not tell the whole story. Oftentimes they develop with extraordinary rapidity, sometimes jumping from 132 to 1,575 per c. c. in a single week, as *Asterionella* did in Walden Pond, Lynn, Mass., in October, 1893. The reason for these sudden and enormous developments is not known. We have tried to associate them with some sudden increase in the amount of food material. But though we have been thus far unsuccessful, it is quite probable that that is the cause. It is possible, as some have suggested, that it is in some way connected with the formation of sporangial frustules, the result of conjugation.

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### Bacteriosis of Rutabaga.

(*Bacillus campestris* n. sp.)

By L. H. PAMMEL,

AMES, IOWA.

During the month of August, 1892, my attention was called to a disease of rutabagas, which, at that time, had consumed more than ten per cent of the crop. The disease was spreading rapidly, owing to the favorable conditions of the weather, warmth and moisture. The ground was very moist, owing to frequent rains in July and early August. The disease became so severe that in some patches, by the middle of September, more than half of the crop was destroyed; it was equally disastrous to some yellow turnips.

In 1893, the disease was again severe to rutabagas; in one case more than fifty per cent were destroyed. A special student, Mr. J. A. Rolfs, who examined a large number of rutabagas for me, makes the following report on the extent of the injury:

"On September 3d I examined the rutabagas east of

the college. In bottom the crop is a complete failure. In three hours of careful search I found one which was exempt. On November 1st the rutabagas north of the college, on high, rolling land, were examined. Here I found not more than half a crop, and those left were of the poorest quality."

Mr. Charles K. Wilkins, of Richland, Neb. wrote:

"We have quite a long row of Golden Ball turnips, and nearly all of them have rotted in the way described by you. We also have some Flat Dutch turnips that are rotting in the same way. Last year we had a quarter of an acre of sugar beets, and some of them rotted, the rot starting in the crown. I have noticed cabbage rotting about here."

This rotting of sugar beets was described quite fully in BULLETIN No. 15, Iowa Agricultural Experiment Station, and is due to *Rhizoctonia betae*. Prof. P. H. Mell reports\* the turnip rot as occurring in Alabama.

#### CHARACTERS.

This disease is easily distinguished by its strong odor, an odor peculiar to rotting rutabagas and turnips. It may be designated as a turnip odor. The roots as well as the stem are affected with a rot that in the majority of cases begins in the crown, although in some cases it appears to start at the bases of the leaves; in others it starts on the sides of the fleshy root. The leaves of rape, rutabagas and turnips, in those rotting as well as not rotting, were uniformly spotted with some disease, probably bacterial; but this has not been worked out. If this should prove to be the same disease it is easily seen why the disease should start in the crown, or at the base of the leaves. The rotting rutabagas could not be detected

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\* Experiment Station Record. Vol.-VI.

till the disease had nearly destroyed the root. Then they were less firm, and but slightly wilted.

In a recently diseased plant the following characters can be made out. The fibro-vascular zone is black, as shown in figure 1. This black zone may be traced from the crown, or the vascular region of the leaf, down into the turnip or rutabaga for some distance, frequently for more than half its length. The zone of parenchyma surrounding the fibro-vascular bundle in recently affected portions have a more watery appearance. In roots where the disease is much advanced the bark separates from the fleshy portion of the root. When the conditions are favorable the rot soon affects the whole root and stem. Frequently the stem and root become hollow, and contain a disagreeable smelling fluid. In some cases this breaks out as shown in fig. 1, page 148; or it opens out on the root farther down. In this semi-liquid substance bacteria of several kinds are found, some having a very active motion. In turnips several different forms were found, most of them bacilli; some of these also exhibited a lively motion.

#### HOW THE DISEASE SPREADS.

In all root-rot diseases with which I am acquainted, the disease spreads from some starting point and extends in all directions, frequently following rows, or circular areas are formed. This disease is no exception to the rule. In one patch the disease made its appearance at one end, spreading in all directions. Frequently a dozen or more plants in a row were affected. In some isolated patches affected rutabagas were found. That this is a disease primarily influenced by the condition of the weather admits of no doubt. As stated before, the disease made great headway in August and early September; but when the dry weather began, it slowly ceased to spread. Dur-



1



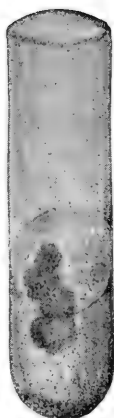
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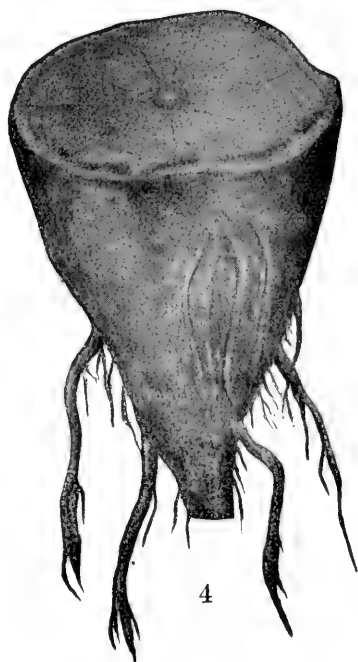
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ing the middle of October but few actively rotting plants were found, and many in which the disease had made considerable progress, ceased to spread. There were no other indications of rot, except that the roots were hollow. Closer examination showed that, surrounding the rotting area, there had been formed by the plant, cork, which protected it. The formation of cork to protect plants from an invading enemy is well known in such diseases as apple scab and potato scab. The spread of this disease seems also to have been influenced somewhat by the age of the plant. Early and very late sown, resisted the disease somewhat better than those planted between the two.

Soil seems not to have been a factor in influencing the disease.

#### CAUSE OF THE DISEASE.

A large number of roots were examined, but in no case could the mycelium of a fungus be found, except where the disease was well advanced. Innumerable bacteria were always found in the decaying substance. These were always found in the black areas of the root, so that the disease seemed to be of bacterial origin. To test this matter several sound rutabagas in the field were inoculated on the side and in crown. The result shows that the rutabagas began to rot in the course of a few days. Mr. Rolfs then inoculated something more than twenty in the same way, with positive results. I am well aware that this is by no means a crucial test, for the rutabagas may have been affected with the rot, but this we could not detect. It is a well-known fact that bacteria, as well as higher fungi, may at times cause decay and rot as a result of mechanical injuries.

The next step was to isolate the germ from rutabagas, as well as yellow turnips, which would produce this rot.

Agar agar roll cultures were then made, from the more or less fluid portion; these gave unsatisfactory results. We then carefully removed with a sterilized scalpel some of the black areas adjoining healthy tissue with a platinum needle, made cultures in agar plates, and roll tubes. Several forms of bacteria were obtained, and one of these a bacillus producing a whitish growth on the surface of the agar agar, when inoculated into an apparently healthy rutabaga produced rot. This was not, however, a crucial test, since the number of inoculations with pure material was too limited; secondly, the rutabagas in the field may have been affected with the disease.

From the same source in 1892 and 1893 we obtained a yellow bacillus; that, too, in the field of 1892, gave some indications of rot. In 1893 we removed to the greenhouse sixteen rutabagas from a field in which the disease had not appeared. The leaves were cut off, the plants carefully cleaned and washed and planted in pots. Eight plants were inoculated with the rutabaga bacillus and eight remained as checks. The plants were inoculated in the following way: knives were sterilized by passing through a flame, and small areas were cut out. Inoculation was then made with a platinum needle from the culture. To prevent the air having access to the plants the cuts were sealed with wax. The plants showed signs of rot in the course of a few days. It made its way along the fibro-vascular bundle, finally involving the whole plant. After these plants had rotted in this way they were removed to the laboratory and then cultures were made from parts of the turnip adjoining unaffected portions; cultures were also made from the black zones. From this material we obtained the yellow bacillus.

#### DESCRIPTION OF BACILLUS.

*Morphology.*—Bacillus varying somewhat in length, from  $1.87^m$ ,  $2.25^m$  to  $3^m$ , width uniform  $.37^m$ . Rods round-

ed at ends, occurring singly or in chains of two or three, staining uniform and readily with fuchsin and gentian violet; in old cultures it stains with difficulty. In hanging drops the bacillus exhibits a lively motion. The organism has considerable vitality, cultures four months old growing readily when transferred. Spores not observed.

*Agar agar.*—Cadmium yellow growth spreading over surface and following track of needle. Grows well at temperature of room.

*Gelatin.*—Cadmium yellow growth follows track of needle; confined to a narrow area of surface. Yellow only on surface, colorless down in medium. Does not liquefy gelatin.

*Potato.*—Rapid growth over surface of potato; round, granular raised colonies; color lighter yellow than on agar.

*Bouillon.*—At first a yellowish white growth on surface, with very slight metallic lustre where pellicle is thin; finally falls to bottom of tube.

*Fermentation tube.*—Five per cent cane sugar. Does not produce gas. Grows in bulb, not in tube. But slightly anaerobic.

*Blood serum.*—Yellow growth along track of needle. No liquefaction. Growth rapid at temperature of room.

*Pathogenesis.*—Produces a characteristic rot in rutabagas and yellow turnips; at first confined to fibro-vascular region, soon involving nearly all of the rutabaga. Strong odor of rotting rutabagas and turnips.

#### EXPLANATION OF PLATE.

Figure 1—Rutabaga slightly reduced, showing rotten part of stem in cross section and breaking out on sides, natural size. Drawn by Miss C. M. King.

Figure 2—Bacilli from fluid part, having motion

Figure 3—*Bacillus campestris* from culture, causing rot, greatly magnified.

Figure 4—Portion of rutabaga showing black fibro-vascular region; which is slightly reduced. Drawn by Miss King.

Figure 5—*Bacillus campestris* culture on agar; slightly reduced.

Figure 6—*Bacillus* culture on Potato. Drawn by Miss Fibbs.

**EDITORIAL.**

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**Dr. Cutter's paper.**—We print this month a paper which the author prepared for the Brooklyn Meeting of the American Microscopical Society. It was not read. Dr. Cutter held himself in readiness to read it but did not have the opportunity, and evidently was much disappointed. He writes: It was accepted but no time for reading assigned. So also, the offer of an exhibition of the 1-75th objective was accepted but no time given it. By hap-hazard I heard of the meeting and when I went I found my paper and objective uncalled for. Indeed, the Secretary said they had gone through the whole program!

As near as we can learn, the facts are about as follows: Dr. Cutter for 30 years has been one of the foremost microscopists of the United States. He has emphatic views and is not slow to express them. There are in the American Microscopical Society a handful of people who run it. They, or some of them, do not assent to all of Dr. Cutter's views. They do not care to waste their time and ability in trying to refute what they would hear from Dr. Cutter. They think it much easier to gag him and crowd him out. Having the control of the Society, this is a sure process. Trying to refute his views by honest argument might not prove a sure process.

But we have seen fit to publish what the Society would not accept for publication; and now we offer the free use of our columns to all who wish to antagonize Dr. Cutter's views, methods, or results.

And, we ask, is the Microscopical Society to be run by a few who chose to rule out of sight such papers as Dr. Cutter's, and who, not furnishing many papers themselves, cause the meetings to be abject failures,—or, will the membership rise *en masse*, see fair play, put competent men in office and make the Society something more than a name. If not some serious organic changes will have to be made. Our own view is that those interested had better go back and revive the Section of Microscopy in the American Association for Advancement of Science, unless a large and influential and catholic society can be built up.

**The Microscope in Detecting Crime.**—A remarkable piece

of detective work resulted in the conviction of Asa G. Gurney, agent of the American Express Company at New Orleans. The facts in the case are as follows:

On the morning of October 15, \$22,500 was found to be missing from a safe containing \$50,000, sent from the bank of Commerce, New York, to the Whitney National Bank, New Orleans. The loss was discovered in the office of the express company at the latter place. There was not the slightest clue to the thief and although clever detectives worked diligently on the case for sometime, they failed to clear up the mystery. At length David N. Carvalho, a well-known New York expert in handwriting, was called in. He began to work upon the express envelope containing the key of the safe which it accompanied and under the microscope discovered the faint impression of a man's right thumb in the wax of a broken seal. It has been shown in numberless instances that the thumb or finger impressions of no two person are alike, and further, that the impressions remain the same from the cradle to the grave.

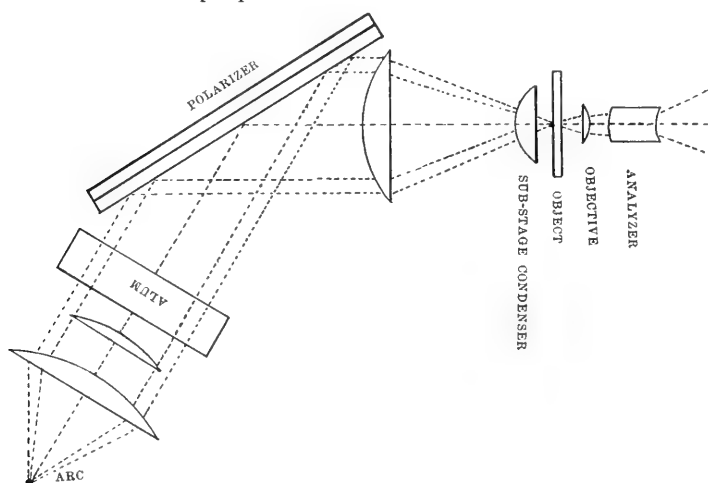
Mr. Carvalho decided to make this discovery the base of his operations. He asked the officials of the company for a wax impress of the right thumb of every man through whose hands the envelope had passed. He did not ask for the names, but carefully refrained from learning them. The company retained the names. Several red wax impressions were given into his hands. They were the thumb marks of seven men who had had possession of the envelope between New York and New Orleans. Mr. Carvalho now set out on the laborious task of tracing some resemblance between the seven thumb marks and the impression on the seal. This was a job of no mean proportions as all thumb marks and the impression on the seal had to be photographed to many times their original size.

But at length after many days' work he discovered that one of the thumb marks was the same in every respect as the tell-tale impression on the seal. The thumb belonged to the company's agent at New Orleans, Asa G. Gurney. Other facts were shrewdly brought out by Mr. Carvalho, which proved his guilt beyond the possibility of a doubt.

## MICROSCOPICAL APPARATUS.

**A Micropolariscope for Projection.**—The projection microscope has long been used to illustrate popular lectures and papers read before microscopical societies.

The N. J. State Microscopical Society frequently resorts to it, and the writer has been trying for a long time to adapt a polariscope to the instrument. On Feb. 25th its performance was shown to the society. A description may be of interest to those who have worked, or who wish to work, on this line. The figure shows how the items of the apparatus are arranged, but does not indicate proportions.



The light comes from an arc lamp provided with an electromagnet for keeping the crater steadily directed toward the condenser, the details of which device were published in the *Electrical Engineer* of March 13th.

The rays diverge from the crater to a plano-convex lens which is one of a pair constituting an ordinary condenser, its mate being shown as receiving parallel rays. Between the first lens and the alum cell is a smaller plano-convex lens of such power as to approximately correct the spherical aberration of the larger lens, so that all rays fall on the polarizer at nearly the same angle, namely about  $35\frac{1}{2}^{\circ}$ .

The liquid in the alum cell is about five-eighths of an inch in thickness, and was prepared by mixing equal volumes of cold saturated solution of alum in water and strong glycerine. Very little alum separates out and any resulting color may be removed by adding to the boiling hot solution enough solution of sodic carbonate to produce a small amount of permanent precipitate which is removed by decantation or filtering.

This mixture seems to absorb more heat rays than does the plain alum solution, so that even glycerine jelly mounts do not suffer. The thickness of liquid mentioned does not suffice, of course, except when the polariscope is used. The polarizer is made of twelve plates of the kind of glass used for covering the best quality of lantern slides. Through the kindness of Mr. Walmsley I obtained glass so colorless that no tint is perceptible in a plate five inches wide, viewed edge-wise.

If tint is unavoidable, a yellowish green is preferable; a bluish tint is the worst.

Before assembling the plates a narrow strip of writing paper was pasted around the margin on one side of each, in order to prevent contact between them, and this paper, as well as the general cover of paper put on to exclude dust, was well wetted with a solution of corrosive sublimate in alcohol. Neglect of this precaution is apt to result in formation of mould between the plates. Polarization of parallel rays, incident at the proper angle, by such a pile is so complete that the margin of the "dark field" is barely distinguishable from the unilluminated portions of the screen.

The transmitted beam is absorbed by a dead black backing. The parallel rays from the polarizer are converged by the second condenser-lens so as to come to a focus upon, or nearly upon, the object. The lens which corrects the aberration of the first condenser-lens gives the further advantage of producing a blurred focus, thus obviating any distinct image of the positive carbon; the rays from the negative carbon do not enter objectives of an inch, or less, in focal length.

Usually an accessory (sub-stage) condenser is needed, though some objectives do well without it. Simple plano-convex lenses work well. The object must be mounted on good

glass and, when possible, in some medium to diminish loss of light by reflection. As to objectives I must say that the best lens of about an inch focus tried by me is a seven-eighths bought of Queen & Co. It gives a bright field about eight feet in diameter, without any substage condenser, much brighter than does any lens I have tested with or without an accessory, and it bears a one-and-one-half inch (B) eye piece well when used with a substage condenser. Of the higher powers several makes of about one half and one quarter inch give good results. The best, so far, in my experience are a one-half (adjustable) of Tolles. and a one-quarter (professional) of Bausch & Lomb. The analyser is a Nicol prism about three-fourths of an inch across the face.

This cuts off some of the field on the screen, but that matters little with "dark field."

Now let me give results, first describing the conditions. The room measures thirty nine and a half by twenty four and a half feet, and is rather dimly lighted. The distance from microscope to screen is thirty one and a half feet. The magnifying powers of the extreme powers used, as determined by projecting a stage micrometer, are three hundred and eighty four diameters with the seven eighths, and fifteen hundred and seventy with the quarter. With the lower power most of the details of sections of granite, and of some other objects of coarse structure, can be seen without turning down the lights. In darkness the image is very bright and distinct. With the higher power, and darkened room, nearly all the smaller polar objects are satisfactorily seen from any point in the room. To specify by a well known object; the larger tous les mois starch grains, (glycerine-jelly mount) are clearly shown with the characteristic black cross. Dichroism and stauroscopic effects not demanding extreme angle of beam, are completely exhibited

Whether these results have been surpassed elsewhere we do not know, and it is hoped that information as to achievements and appliances will be elicited by this communication.—F. C. VAN DYCK.

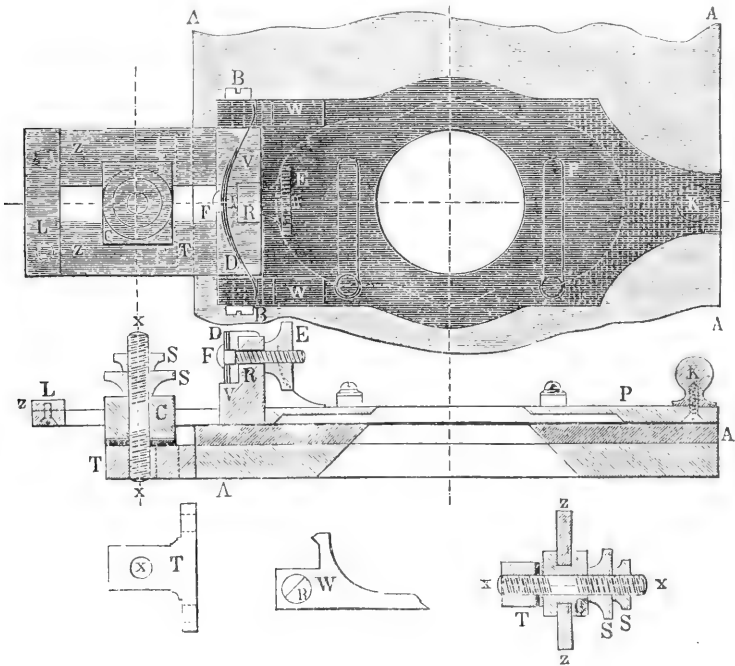
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**The Differential Object Guide.**—Under this heading the *Zeitschrift für wissenschaftliche Mikroskopie* (vol. XI, 1894) gives a description of a new stage, designed to cover a larger field of usefulness than our familiar forms now possess.

The differential object guide allows of mechanically regulated movements as well as irregular ones, and achieves this by the direct act of the hand, which during work does not change its hold. These points precluding the use of screws, or pinions as



interposed means of motion, the principle of “differential friction” was adopted. The guide performs its functions by sliding motions, and the friction inherent to these is so divided among the several parts of the instrument that the greater, or ruling friction is assigned to the lateral, and the minor friction to the to and fro motions. If the ruling friction is allowed to control the movements the effect of a mechanical stage is produced, if, however, the guiding hand overcomes the ruling friction by ignoring it, the movements can directly be adapted

to the forms under observation, yet, with greater ease and accuracy than by the use of the ordinary hand stage. These two kinds of motions are constantly at the microscopist's immediate disposal, by simply grasping the knob of the guide between his thumb and forefinger.

Turning our attention now to the drawings, we see that part of the microscope stage, A A, to which the object guide is immediately attached. This is done by the T piece T, provided with an upright pillar X, serving as an axis to the grooved block C, and representing the motion centre of the instrument. There is a spring between T and C. Sliding in the partially leather-lined grooves of C is the forked, or fenestrated plate Z Z, and linked to this by the screws B B, the plate P, provided with spring clips and a knob K; C having received the plate Z, is by means of S S adjusted at such a height above T that P lies parallel to the stage A A. It is to be noted that plate Z, by means of the grooved block C and the vertical axis X, invariably—whether at rest, or in motion—occupies a position in a horizontal plane, corresponding to that of A A. Connected with Z, a vertical post R is seen, lodging a small bolt F which carries an arched compound spring D on the left, and a milled screwnut E on the right side of R. The arched spring with either of its extremities acts on an upright, W W, forming part of plate P, Z and P being connected by a hinge joint, and Z being confined to a horizontal plane, the action of D results in a pressure exerted by P on the stage of the microscope, and by Z in the grooves of C. At the moving of the instrument this pressure causes friction, the requisite amount of which is secured by regulating the tension of D by means of E. Comparison shows, and it is clear without further explanation, that the friction in the grooves of C is greatly in excess of that on the stage of the microscope, and that owing to this fact, the operator—holding K loosely between his fingers—is enabled to move the guide to and fro without producing any lateral motion. It requires a somewhat firmer grasp of K to move the guide laterally through the field of vision, followed again by a motion to and fro, and so on, alternately.

In morphological studies the operator pays no attention to the ruling friction in C, but simply follows the outlines of the

object. Yet, even in investigations of this class he may temporarily allow the friction in *c* to take control of the movements, which will be found a great convenience.

In order to avoid scratching the surface of *A A*, the under side of *P* is provided with a strip of firm cloth lining near *κ*.

The simpler kinds of microscope stands not possessing fine adjustment, can with advantage and at small cost be supplemented in this direction. For this purpose the object guide has to perform the additional function of fine adjustment. The modification essentially consists in the plate *P* being double, a micrometer screw passing through knob *κ*, acting on the lower plate. For histological class work and clinical purposes this arrangement is quite satisfactory and very convenient.

The here described instrument which is not patented, is the invention of Dr. H. E. Hildebrand of Chicago, and is supplied by Richards & Co., 103 Lake St., Chicago, and 41 Barclay St. New York.

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## MICROSCOPICAL SOCIETIES.

### Quekett Microscopical Club.

The annual meeting of the Quekett Microscopical Club was held at 20, Hanover-square, on Friday, 15th Feb. last, the President, E. M. Nelson, in the chair. The following were elected officers and committee for the ensuing year: President, E. M. Nelson; vice-presidents, Rev. Dr. W. H. Dallinger, Prof. B. T. Lowne, A. D. Michael, Prof. C. Stewart; treasurer, J. J. Vezey; secretary, G. C. Karop; foreign secretary, C. F. Rousselet; reporter, R. T. Lewis; librarian, A. Smith; curator, E. T. Browne; committee, H. Morland, E. Dadswell, D. Bryce and F. A. Parsons.

The report for the past year and the treasurer's statement of accounts were read and adopted. The secretary, whilst urging on the members to help increase the usefulness of the club by the introduction of new members, said that they may be considered to be in a fairly satisfactory condition, for during the past year they had been enabled to invest a portion of their annual income in Consols.

The President read the annual address, taking for his subject

the Progress of Microscopy in 1894. He first called attention to the fact that during the past year considerable activity had been shown in the "brass and glass" world. Several new models of microscopes and new forms of apparatus having been produced, he adverted to Herr E. Leitz's microscope with a "bent claw" foot, which appeared about the end of 1893, and which was at present a nearer approach to the English model than any other Continental microscope that had hitherto been made. The President then referred to the three and four-legged stands of Messrs. Swift, to the new mechanical stage, and to the improved form of Cambridge Rocking microtome of the same makers. Messrs. Ross and Co's "Eclipse" microscopes were criticised, and Mr. Nelson commented favorably on the ring-foot adopted by these makers for this class of student's microscope. Messrs. Watson's new model "Van Heurck" stand was noticed, as was also Messrs. Baker's photographic microscope, and their instantaneous photographic shutter, which had been adapted for photo-micrography. The President called attention to the progress that had been made in light screens for photo-micrography and critical illumination, referring especially to the work done in this direction by J. W. Lovibond and J. W. Gifford, which he considered would lead to most important results. After reviewing a pamphlet by Allan Dick, describing how his petrological microscope could be used for general microscopic work, the remaining portion of the address was given up to a most lucid review of Lewis Wright's theory of microscopic vision, which appeared in the *ENGLISH MECHANIC* during the past year, and which Mr. Nelson considered to be a most valuable contribution to the study of microscopic optics.—*English Mechanic*.

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### MICROSCOPICAL NOTES.

**Vaselin in Microscopy.**—Gawalowski proposes to replace cedar oil and other liquids used for oil immersion for objectives by vaselin, whose refractive index is 1.40.—*Rundschau*.

**Fine Mounts of Caterpillars.**—Mr. C. P. Bates, 853 Main street, Petaluma, Sonoma County, California, prepares fine mounts of Caterpillars. We advise those who are interested in the subject to correspond with him.





W. W. ROWLEE,

CHAIRMAN OF THE LOCAL COMMITTEE FOR THE ITHACA MEETING OF THE AMERICAN SOCIETY  
OF MICROSCOPISTS.

# THE AMERICAN

## MONTHLY

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### An Improved Method for the Microscopic Investigation of Crystals.

BY A. E. TUTTON.

[Adapted From *Nature* April 25, 1895.]

A memoir of considerable importance to all who are interested in the microscopic determination of the characters of crystals, is contributed by Prof. Klein to the *Sitzungsberichte* of the Berlin *Academie der Wissenschaften* for January 31, 1895. The two essential points of the communication are that a form of stage goniometer is described, which permits of the most complete examination of many of the principal zones of the crystal with one and the same setting of the crystal upon its holder, and that the crystal is immersed during the observations in a liquid whose refractive index is about the mean of the refractive indices of the crystal. The idea of the "Universaldrehapparat," as the new stage goniometer is termed, appears to have suggested itself almost simultaneously to Prof. Klein and to Herr von Federow, for the former described an earlier form of it in 1891, while the latter described an "Universaltischen" in May of the same year in the *Zeitschrift fur Krystallographie*. Federow had previously contributed to the *Zeitschrift* a remarkable memoir concerning a theololitic universal goniometer, and the application of the principle of that instrument to the microscope goniometer followed naturally therefrom. The present memoir of Prof. Klein

affords so admirable a description of the improved instrument, which has been constructed for him by the well-known Berlin crystallographical optician, Herr Friess, and likewise of the mode of employing it in connection with the immersion method, that all will be interested in it. Unfortunately the illustrations of Klein cannot be reproduced.

The microscope should be one of the petrological type fitted with the usual accessories for the examination of crystals in parallel and convergent polarized light. The particular instrument constructed for Prof. Klein is somewhat similar to the largest Friess model. It is so arranged with respect to the centre of gravity that it can be rotated into the horizontal position whenever desired, a point of some importance with regard to the use of an immersion liquid. The stage is circular and divided so as to read with the aid of a pair of verniers to single minutes; it is further provided above with two graduated rectangular traversing movements, one of which is supplied with a micrometer registering 0.01 mm., while the other is capable of much more rapid motion. The advantages of the simultaneous rotation of the polarizing and analysing nicols, as adopted in the microscopes made by Mr. Swift under the direction of Mr. Allan Dick, have been so well appreciated by Prof. Klein that this has been arranged for in the new Friess instrument. The carriers of the nicols are each furnished with a toothed flange capable of gearing with a small pinion, and the two pinions are arranged at the ends of a connecting rod furnished at a convenient height near the upper pinion with a milled flange by means of which rotation can be effected. Provision is made for the lengthening of the connecting rod when the focussing of the microscope by the rack and pinion or by the fine adjustment is effected, and care is also



taken that the rotation by means of the connecting rod shall occur without dead-space or backlash. Prof. Klein states that some important details in connection with improvements in the mode of carrying out this simultaneous movement of polarizer and analyser will shortly be published by Herr Friess. Provision has likewise been made for correcting at any time the setting of the nicols in their carriers, experience having shown that the setting invariably alters slightly in course of time. In addition to the eye-piece nicol capable of being connected with the polarizer in the manner just described, there is likewise provided the usual nicol capable of sliding in or out of the microscope tube just over the objective. Above this, and just below the eye-piece, a Bertrand lens for observing interference figures in convergent light is capable of sliding in and out of the tube, and is intended to be employed in conjunction with a converging system of lenses capable of being carried in a tube attachment beneath the level of the stage. The remaining details of the microscope are the same as are usually supplied with a No. 1, Friess instrument.

The stage goniometer is intended to be employed with the microscope arranged horizontally, as it is found inconvenient to employ our immersion liquid with a vertical arrangement. The base-plate of the goniometer, consisting of a stout metal plate with fairly large central aperture, is fixed by a suitable clamping arrangement upon the new vertical stage of the microscope. The plate is continued into a short arm on that side which is uppermost when fixed in position, and this arm carries near its end, and at right angles to it (horizontal when in position), a projecting piece terminating in the supporting cone for the goniometer circle, and which also carries the vernier reading to five minutes and the fine adjustment. The circle is hollowed in its upper cen-

tral part, and perforated with a central aperture; this permits of the sliding movement within the hollow, for centering purposes, of a disc which carries the axis of the instrument. To the lower end of this short axis are attached the movements for adjusting the crystal, and the lower of which carries the crystal. The adjusting movements are a pair of circular quadrants arranged at right angles to each other and graduated. They are simpler in construction, and lie much closer together than those of the best forms of goniometer now in use for ordinary goniometric and spectrometric work, and are therefore particularly suitable for use in connection with the microscope. The upper quadrant is fixed to the axis; over it a slider is capable of moving, which carries a vernier, and below it the lower quadrant, which in turn is fitted with a slider terminating in the holder which carries the crystal cemented by wax. The verniers enable readings of five minutes to be obtained, the same degree of accuracy as in the case of the circle.

The glass cell containing the immersion liquid is supported in position normal to the axis of the microscope by means of a stand with an adjustable arm placed to the left of the microscope. It is recommended to have a series of cells, ready for filling with various media of the most frequently required refractive power. The advantages of Adams' method of determining optic axial angles may also be combined with those of the method now described, by use of a cell consisting of an upper cylindrical portion terminating below in a sphere filled with the liquid. As regards suitable liquids, an admirable list is given by Herr Pulfrich in his book descriptive of the construction and use of the total reflectometer recently devised by him (p. 64). Two errors in that list, however, are corrected by Prof. Klein; he has been unable to prepare the solution of mercuric iodide in ani-

line and quinoline of refractive index 2.2, and the refractive index of the phenyl sulphide kindly supplied by Prof. Klein's colleague, Prof. Emil Fischer, is only 1.56 instead of 1.95. If the dangerously poisonous and inflammable liquids are excluded, the list consists chiefly of oils, the well-known Thoulet solution, monobrom-naphthalene, and methylene iodide. The solution of iodine in the latter frequently renders it insufficiently transparent for the purpose.

The determination of the true angle,  $2V$ , between the optic axes within the crystal, supposing it to be biaxial, can at once be determined with the aid of the new apparatus, by immersing the crystal in a liquid whose refractive index is equal to the beta (intermediate) refractive index of the crystal. The condensing system of lenses is first inserted between the polarizing nicol and the stage, and the Bertrand lens above the analyzer; as objective, either the ordinary wide angle combination usually employed for convergent light work, or a specially constructed one supplied for the particular purpose of convergent light observations through an immersion liquid is employed. This objective is so constituted that as large a field of vision as possible is afforded, while the distance between the objective and crystal is considerably greater than with the ordinary system in use. The apparent angle of the optic axes in air,  $2E$ , may first be measured, if desired, after adjustment of the crystal by means of the adjusting movements, by bringing the hyperbolic brushes to the cross wire of the microscope eye-piece in the usual manner. The immersion cell not being in position while this is being achieved, the objective can be approached nearer to the crystal and one of the ordinary forms of convergent light objective employed, which affords a larger angle of vision, reserving the special objective for the determination of the

true angle of the optic axes. If, however, the Adams spherical cell is employed, there is no necessity even here to use the special objective, as the older wide angle form serves admirably. With the parallel sided cells it is preferable to use the special objective. The Adams sphere is not supported similarly to the rectangular cells, but is conveniently held by its cylindrical neck in a small support directly attached to the lower quadrant of the adjusting apparatus. The measurement of the true angle of the optic axes is then carried out in the usual manner, similarly to the determination of the apparent angle in air, while the crystal is immersed in the liquid contained in one or other of the two forms of cell. Monochromatic light should of course be used in making the observations, a sodium flame some little distance in front of the polarizer being employed by Prof. Klein.

The great advantage of this method of determining the true inner angle between the optic axes lies in the fact that it is totally unnecessary to prepare section plates of the crystal, the whole crystal itself being employed, and thus material saved. Prof. Klein does not claim for it the highest attainable accuracy, and for the class of work such as that with which some are identified, the determination of the crystallographic characters of series of isomorphous compounds closely resembling each other, where every endeavor must be made to attain the upper limits of experimental accuracy, such a method is of course inadequate. But for the ordinary description of minerals and the crystals of isolated chemical preparations unlikely to be injured by the immersion liquid, and particularly, for laboratory teaching, the method is one of the simplest and most interesting yet described. The accuracy depends entirely upon the closeness of the approximation of the refractive index of the liquid to the beta index of the crystal. Of course it

will rarely happen that coincidence of these values will occur for all colors of the light employed, the dispersion of the crystal and the liquid in general being different. So that although the values may be coincident for sodium light, they would in all probability be different for other colors. But if the observations are only conducted for sodium light, a process which is frequently sufficient for the purpose in view, then this objection entirely disappears. Moreover, the errors introduced by the discrepancy for different wave-lengths of light would not be sufficiently large in most cases, if observations for other colors were made, to materially reduce the value of the method for the purposes for which it was designated.

A consideration of the simple formulæ connecting the optic axial angle with the beta refractive index and the refractive index of an immersion liquid will at once render the value of the method, within the above specified limits, clear. Representing as usual the real semi-acute angle between the optic axes within the crystal by  $V_a$ , the semi-obtuse angle by  $V_o$ , and the apparent semi-acute and obtuse angles in the immersion liquid by  $H_a$  and  $H_o$  respectively, the refractive index of the medium for light of the same wave-length being  $n$ , then :

$\sin V_a$  equals  $\sin H_a$  and  $\sin V_o$  equals  $\sin H_o$ .

These two equations are of the same kind, for both  $V_a$  and  $V_o$  are less than 90 degrees; and the only variables are  $n \sin H_a$  and  $n \sin H_o$ , for beta,  $\sin V_a$ , and  $\sin V_o$  are constant quantities for this wave-length of light. If, now, the sum of the angles  $2 H_a$  and  $2 H_o$  is greater than 180 degrees, the common factor  $n$  must, in order to bring the sum of these angles down equal to 180 degrees, be increased, that is, a liquid of higher refractive power be employed. Conversely, if the sum is less than  $180^\circ$  the refractive power of the liquid must be diminished in order to bring the sum of the angles up to  $180^\circ$ . For

the specially interesting intermediate case where  $n$  equals  $\beta$ , the sum of  $2 H_a$  and  $2 H_o$  will be exactly  $180^\circ$ , and  $\sin V_a$  equals  $\sin H_a$  and  $\sin V_o$  equals  $\sin H_o$ , when also  $V_a$  equals  $H_a$  and  $V_o$  equals  $H_o$ .

From the above theoretical consideration one can immediately deduce the course to be taken to render the immersion liquid exactly equal to the *beta* index of the crystal; if the measured values of  $2 H_a$  and  $2 H_o$  add up to over  $180^\circ$  a liquid of higher refraction must be obtained, and *vice versa* if the sum is less than  $180^\circ$ . There are, however, several different ways of determining the closeness of approximation of the indices without going to the trouble of actually making preliminary measurements. In the first place the crystal will disappear in the liquid, that is to say, will be invisible, provided that it is colorless, when its refractive power is equal to that of the surrounding medium, especially when the line of the observer's vision lies in the plane of the optic axes. This is very beautifully observed when calcite is immersed in monobromnaphthaline, and particularly when it is arranged so that the observer looks along the direction of the vertical axis of the crystal; under these conditions the latter is completely invisible. In the second place, instead of hyperbolic curves passing through the positions occupied by the optic axes; the brushes will take the form of almost straight lines when the refraction of crystal and liquid is about the same.

In choosing crystals for observation by the new method, Prof. Klein recommends that individuals or fragments should be selected which are equally thick in two perpendicular directions in the plane of the optic axes, that is, such as are almost cylindrical in appearance, and not too thick to prevent the interference figures being observed. When immersed in the liquid, it is as if at each moment, and for every position during rotation of the

crystal, a parallel section-plate were being examined, the natural faces of the crystal—however, rich in faces the zone may be—not entering into consideration whatever.

The advantages of the use of an immersion liquid of equal refractive power in the examination of crystals have been pointed out by several previous observers. In 1841, Biot, in his memoirs concerning lamellar polarization, describes the use he made of it. The method has long remained dormant, however, as far as is known from the literature of this branch of study. In the 8th Ed. of the *Lehr. der Physic und Meter*, it is stated that if the refractive index of the liquid in which a plate perpendicular to one of the medium lines is immersed is equal to that of the crystal, the true angle between the optic axes is at once afforded. Latterly, however, the evident advantages of the method have suggested themselves to several crystallographers. M. Fougucé mentions it in his memoir in the Bulletin of the French Mineralogical Society of 1894 on the felspars.

The writer of this article has frequently made use of the method for certain specific purposes and it may be of use to other workers to give a brief indication of one or two modes of extending its sphere of usefulness not touched upon by Prof. Klein. In the course of the investigation of the normal sulphates of potassium, rubidium, and cæsium, (Jour. Chem. Soc. 1894, 628) a difficulty was found in determining the true optical axial angle of rubidium sulphate by means of the very accurately orientated section-plates prepared by use of the new grinding goniometer described to the Royal Society, (*Phil. Trans.* 1894, A 887) earlier in the same year. The difficulty, which is one not uncommonly met with, was owing to the fact that the extremely low double refraction, necessitating the use of very thick sec-

tion-plates, combined with the slight separation of the optic axes, rendered it impossible to measure the obtuse angle in monobromnaphthaline, and so to calculate the true angle by means of the formula

Tan Va equals Sin Ha divided by Sin Ho.

The difficulty was surmounted, as fully described in the memoir referred to, by measuring the acute angle by means of section-plates perpendicular to the first median line immersed successfully in two liquids, benzene and cedar oil, whose refractive indices were nearly, and the mean of them exactly, equal to the mean refractive index of rubidium sulphate. The two series of valves obtained for six wave-lengths of light (the monochromatic light producer as described in *Phil. Trans.* 1894, A 913, being employed) were almost identical, differing only by a very few minutes, and the mean for each wave length was taken as representing the true angle of separation of the optic axes for that particular wave-length. The method is applicable to all cases where it is found impossible to see the hyperbolic brushes through a section perpendicular to the second median line on account of the slight separation of the optic axes. Mr. Miers has had a goniometer constructed for the express purpose of studying the use of an immersion fluid.

Another case in which observations in such a liquid are of great value when it is found desirable to confirm, in some independent manner, the mode of dispersion of the optic axes for different colors indicated by the calculated valves of 2 Va obtained from the formula last quoted. Several of the compounds which the writer has lately been engaged in studying exhibit very low dispersion of the optic axes, and the calculated values of 2 Va for five wave-lengths, obtained from the measurements of the apparent acute and obtuse angles in monobromnaphthalene by the use of accurately orientated



section-plates, are so close together that it was considered advisable to ascertain in some other manner whether the order of dispersion was truly represented; that is, whether the angle for one end of the spectrum was really very slightly greater than that for the other end, or whether the amount of dispersion thus indicated did not really fall within the limits of experimental error, thus leaving it possible that the dispersion might even be of the contrary order. By immersing a plate perpendicular to the first medium line in a liquid of refractive power equal to the medium refractive index of the crystal, the interference figure in white light usually at once indicates, by the colors exhibited on the margins of the axial brushes, the order of dispersion, and measurements of the axial angle for the two extreme wave-lengths afford an immediate check upon the accuracy of the calculated angles. It is a considerable source of satisfaction to be able to confirm such calculated optic axial angles in so simple a manner.

Prof. Klein further describes how admirably the new apparatus is adapted for the determination of the extinction angles upon the various faces of a zone, in parallel polarized light. For this purpose the converging lenses are removed, and the eye piece analyzing nicol is employed, so that the polarizing and analyzing nicols may be arranged for simultaneous rotation. The measurements are carried out while the crystal is immersed in the liquid as in case of the determinations of optic axial angle. The only precaution necessary is that the crystal should be uniformly illuminated in order that the exact position of extinction may be ascertained by use of one of the usual half-shadow stauroscopic plates.

The memoir concludes with a description of the general mode of investigating a biaxial crystal immersed in a liquid of equal refractive power, indicating how the

principal planes of optical electricity may be found, the positions of the optic axes ascertained, and the true internal angle of the latter measured. One of the most important advantages of the method is the simplification which it introduces into the study of triclinic crystals, hitherto almost dreaded by the crystallographer for the trouble they involve. It would appear that their optical investigation by the immersion method offers but slightly more difficulty than that of crystals of higher symmetry, the positions of the optic axes being readily found and the true angle at once afforded. This alone would entitle Prof. Klein to the thanks of crystallographers and mineralogists for perfecting so admirable an aid to investigation.

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### A Description of a Simple and Reliable Method to Trace the Nerves in the Muscle.

By CHR. SIHLER, M. D.,

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The process employed in this method consists of three parts:

1. The fresh muscle is treated with a macerating fluid, which partly dissolves, partly softens, the connective tissue, substances between the muscle, and nerve-fibres, allowing the staining fluid free access to the tissue elements, which it is the object of the staining fluid to penetrate and to make demonstrable.

2. The softened and loosened muscle-bundles of sufficiently small size are stained in dilute Ehrlich's hamatoxyline.

3. Overstaining generally taking place, the stained muscle-bundles are treated with dilute acetic acid until the nerves and nerve-endings show up distinctly.

The maceration fluid (*a*) has the following composition :

Common Acetic Acid.....	1 P. (fluid)
Glycerine.....	1 P. “
Sol. Chloral Hydrate (1 per cent aqueous)	
.....	6 P. “
The staining fluid ( <i>b</i> ) has the following composition :	
Common Acetic Acid.....	1 P. (fluid)
Ehrlich's Hæmatoxyline.....	1 P. “
Sol. Chloral Hydrate (1 per cent. aqueous)	
.....	1 P. “

Distilled water must be used in preparing the solution of chloral, and the Ehrlich's hæmatoxyline ought not to be too fresh.

Muscle bundles of which we are certain that they contain nerve-endings of the thickness of a goose-quill (or thinner) are left in *a* for about eighteen hours. From this they are transferred into glycerine until they are thoroughly saturated (one to two hours). The muscle-bundles must now be split up still further, which is not difficult to accomplish, especially if they are pressed flat first between two plates of glass, so that pieces of the thickness of a knitting-needle are obtained. These are thrown into *b*, where they remain until they are deeply stained, which may require anyway from three to ten days. Inasmuch as the muscle is generally overstained, it is of no importance if the tissues remain in the staining fluid longer than is absolutely necessary.

It is of importance to remember to use both fluids in sufficient quantity, so that the gelatinous substances are thoroughly removed and do not interfere with the staining of the protoplasmic structures, ten times as much fluid as tissue would seem about right; but it is better to have too much than too little. From time to time a sample may be taken from the staining fluid and teased out in acetic acid and glycerine to find out when the staining process can be ended. If the nerves accompany-

ing the capillaries can be clearly distinguished by their blue staining we can expect the nerve-endings to be stained also, the former, however, will at once strike the eye, and so this process will require but little time and labor. In case the staining fluid does not acquire a blueish tint it had best be poured off and be replaced by a second quantity.

The muscle-bundles, when sufficiently stained, are washed thoroughly in tap or well water and then thrown into glycerine, which is best changed a few times; and in this fluid they are now kept until they are to be further examined. Then one or several of the little bundles are taken from the glycerine and teased out, or, rather, split up further, in such a way that the fibres are disarranged as little as possible, and treated with acetic acid. If one is in a hurry, the teased out bundles are placed in a watch-glass of acetic acid, which is allowed to act until the dark blue stain of the tissue is converted into a violet one. If there is no lack of time, the muscle-bundles are kept in a mixture of acetic acid and glycerine until they have assumed a lighter color. A little experience will soon show the details of this part of the process.

The muscle, when taken out of the staining fluid, has a uniformly blue appearance; the nuclei only have a black-blue color. The acetic acid now has this effect, that the substance of which the bulk of the muscle substance is built up, readily parts with its color, while the fibre system of Gerlach (according to others, the sarco-plasma), which by its regular thickenings and cross fibrils produces the cross-striation, retains the stain to the same degree that nerve-fibres do.

In a successful specimen, therefore, the muscle-fibres as a whole appear pale blue, while their narrow cross-striations (and longitudinal fibrils) have a deeper blue color. The pale nerve-fibres have a similar hue, while

the medullated nerve-fibres are darker. The nuclei are stained black-blue. A difference between the nuclei of different tissues is not apparent.

The most beautiful specimens I have procured from muscle-bundles were those which, after being stained, had been kept in glycerine eight to ten months, to which *I believe*, I had added borax. In this material I found many sarcolemma sheaths empty and partly empty, allowing thus the nerve terminations to appear very distinctly, and the nerves supplying the capillaries to show with unusual clearness. Apparently, the borax had completed the process which the acetic acid had begun, viz., solution of the cement substances. This material was not treated with acetic acid, and perhaps by using thicker muscle-bundles one might obtain material not overstained where the washing out of the stain by the acetic acid would not be necessary.

These directions are suitable for ordinary muscles of the frog. The heart requires a milder process, nor is it necessary that the bladder remain for eighteen hours in fluid *a*. The intercostal muscle of the rat, however, required more than twenty-four hours, so that different tissues require different modifications of the method.

If a number of muscles are to be investigated, the vascular system of the frog is first washed out with *a* and then as much of it forced into the vessels as can be gotten into them. After this procedure it is an easy task to split up the cut-out muscles which one may select, into smaller pieces, with the aid of needles and the handles of a scalpel.

To facilitate the obtaining of pieces small enough for the staining fluid and to make the mechanical separation of the muscle fibres very thorough, I take the pieces of muscle soaked in glycerine—before they are stained—place them between two panes of glass and subject them

to very thorough pressure, so that the bundles are flattened out. These flattened out bundles are now readily split up further without their fibres being disarranged. This manipulation I have learned from Beale's—"How to Work with the Microscope."

It is not to be expected that on a subject which has been investigated for years by the ablest men, much new matter could be said; and my principal object in writing this paper is to enable such as—like myself—have neither

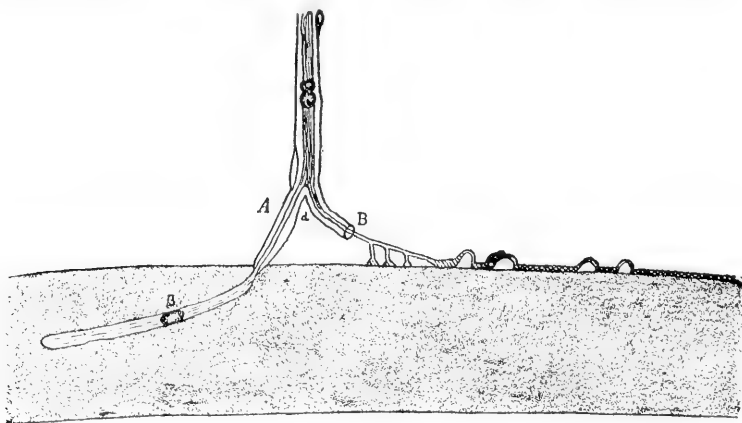


FIGURE 1.

the skill nor the time to obtain good results with the gold method, to demonstrate to themselves the very interesting histological facts under consideration. The copies of specimens which are being sent around are to demonstrate that this method brings out all the gold method does. Nevertheless, I have prepared three diagrammatic figures, for the purpose of calling attention to certain points which are of scientific interest.

Figure 1 shows a nerve termination. If we follow the nerve we see that at (*d*), where the medullary sheath ends, it grows very thin and then splits up into two branches. At (*A*) we see what the books describe. The sheath of

Henle *seems* to coalesce with the sheath of Schwann, and if one has no difficulties on account of the nucleus (6) one can *imagine* he sees the nerve-fibre penetrate the sarcolemma. The other fibre (*B*), however, shows the real condition of things. Here we see that Henle's sheath is open—the nerve protrudes from it, applies itself, forming a narrow plate, to the muscle-fibre; then forms a little arch with concavity towards the muscle, comes in contact again, etc. It is not my purpose now to discuss the

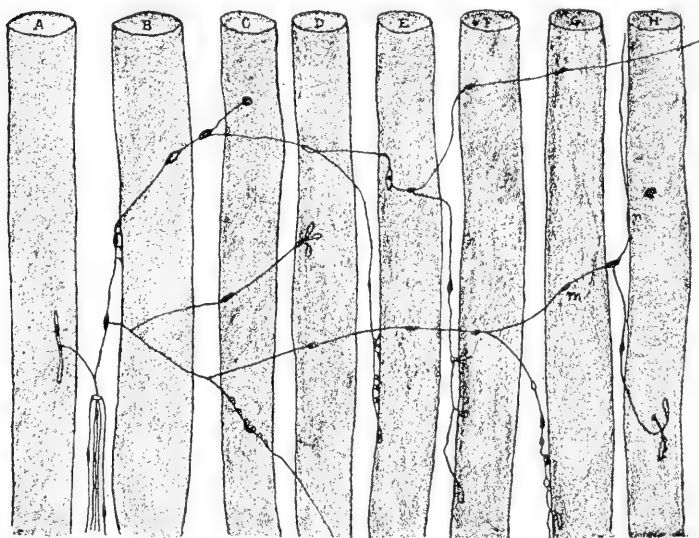


FIGURE 2.

question as to the situation of the nerve-endings, and will only say that such facts do not seem to speak in favor of the teachings of Kuehne, according to which the end fibrils of the nerve are situated underneath the sarcolemma. I must remark, however, that the whole end fibril (*A*) corresponds to one of the parts of the end fibril (*B*) cemented to the muscle-fibre, and the apparent coalescence of the Schwann and Henle is brought about

by the fact that the sheath of Henle generally ends at that place, where the fine end fibril widens out to apply itself to the muscle-fibre.

Figure 2 shows the fine nerve-fibres supplying the muscle-fibres in a way which differs somewhat from that generally described in the books—a modification of nerve supply which is quite common in the muscles of the forearm, the tongue, the eyes. Generally, I have found this disposition of the nerves in connection with muscle-bundles that were of uniform and rather small calibre.

I would call particular attention to muscle-fibres *G* and *H* because the nerve at *m* and *n* is connected with the muscle without a special end apparatus. That a connection between muscle and nerve, however, exists here one can demonstrate by pressing the cover-glass, whereby traction is exerted on the nerve, and thus it can be seen that the nerve is not merely in apposition to the muscle-fibre. In a similar way we can imagine plain muscle-fibre to be supplied with nerve.

I strongly suspect that the nerves which Kolleker describes as the sensory nerves of muscle (page 388, 6th edition) are only such a modification of the motor nerves as I here describe.

Figure 3 treats of such an important subject that one might spend hours in discussing it. We see here a nerve-bundle with two nerves. The thicker one supplies a muscle-fibre of the tongue in such a way that it is cemented to the muscle-fibre for a certain distance, then forms an arch, then applies itself to the muscle-fibre again, etc. If I understand Kuehne correctly in his description of Figures 50 and 51 in his elaborate essay of 1886, he places the entire ending, arches and all, beneath the sarcolemma. I hope the described method will convince some that this view is not correct.

The other, finer (sympathetic), nerve-fibres go directly



to the capillary; and there are two important facts brought out to which I wish to call special attention: one is that the nerves are centrifugal, or motor nerves; the other, that the capillaries have a direct nerve supply, and that the nerves which we find in connection with them are not simply the continuation of those supplying the larger vessels (arteries and veins).

These nerves are very fine, but show little expansions

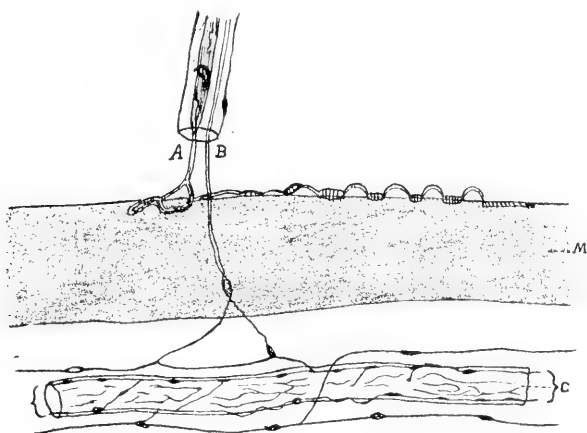


FIGURE 3.

at short intervals, where they are in absolute contact with the vessel, which expansions one might consider as a sort of end plate. I have also observed repeatedly that cross branches are given off, at times a number close together, but I cannot decide whether these entwine the vessel or end in little plates. These nerves are very easy to overlook and often can only be recognized by their nuclei, which form a protrusion on the outline of the capillary, being situated, of course, on the outside of the vessel. It is very common for a pair of such fibres to run along on a capillary. One must, of course, not confound these nerve-fibres with those running alongside of the capillary, and which can be seen readily. The

latter, of course, are to be looked upon as the trunks, of which the former are the branches.

I would call especial attention to these structures and their arrangement, because physiologists seem entirely to ignore them. In several of the latest text-books, at least, I do not even find them mentioned, and thus a discussion of their function at this time cannot be expected; and yet the nerve supply of this system is as large as that of the motor nerves of the muscle. For if we take into consideration the size of the cells forming the capillary wall, and compare this with that of the muscle-fibre, we see that the nerve supply of the capillary is immeasurably larger than that of the muscle-fibre and we are justified in assuming that we have to deal here with a very delicate and important physiological apparatus. We see, further, that these nerves are branches of the sympathetic nerve; that they have centrifugal function; that through their activities the cells of the capillary wall are stimulated to execute certain actions as the muscle is stimulated to contract by its nerve. Experimental pathology further shows us what sort of activity the capillary wall is engaged in. If it is irritated we see that a larger quantity of serum passes through its walls, that the irrigation stream is increased.

If we now take together the results of experiment and the histological facts, it seems to be a permissible hypothesis to assume that through the influence of these nerves the flow of the lymph current from the blood to the tissues can be increased—or rather regulated, so that while, *e. g.*, the nerve-fibre (*A*) stimulates the muscle-fibre, causing it to contract, the nerve-fibre (*B*) would cause the cells of the capillary wall to allow a larger amount of lymph to be poured over the contracting muscle. It is by no means necessary to consider this action of the capillary cells as one of contraction but rather some-

thing of that nature, which the physiologists ask us to imagine when they say that the activities of gland cells can be called forth by stimulation of the nerves. (There is only this difference that I point out—the nerves necessary for the activity of the capillary, while for that of the gland cells the nerves are assumed. Thus no new demands are made on the faith of the physiologists.) The relation of capillary cells to the blood current and their flat shape seem, furthermore, to make these structures well adapted for such assigned functions.

I am therefore, of the opinion that we have here in the nerves supplying the capillaries of the muscles those structures that correspond to the nerves which call forth secretion in the glands, and not in the nerves supplying the muscle-fibres themselves, calling forth contractions. The formation of carbonic acid and other substances, with the solution of heat, would therefore correspond to the formation of saliva, while I have also looked in vain for nerves supplying the gland cells. I have found them supplying the capillaries as abundantly as in the capillaries of muscle in the sub-maxillary of the cat and dog. The mucous glands in the frog's tongue furnish such favorable subjects for the described method that one would expect to find them here; but even with these structures I have not been successful. Why, then, can they be found on the cells of the capillary wall and not on the gland cells, while the latter are far more massive organs than the former?

If, however, the fact that the capillaries are supplied with nerves and the peculiar structure of the capillaries are not entirely ignored, it is not at all necessary to ascribe nerves to the gland cells. The fact of experiment and the ordinary function of the gland can readily be explained by these nerves of the capillaries, but one must not identify the effect of their activity with the vaso-

motor (resp. vaso-dilator) nerves. There are, then, several objections that can be raised against the theory of glandular activity, which is now dominant.

First, it must not be forgotten that in the production of glandular secretion, it is necessary above all things that fluids be furnished in great quantities, in which the substances prepared by the gland cells are dissolved; a production of these substances without the dissolving fluid would be purposeless. Why should there be special nerves for useless functions? Suppose, however, we should assign nerves to the gland cells, we could, adducing muscle as an analogy, understand that upon nervous influence the metabolic activities peculiar to the gland cells might be enhanced; but to imagine that through the same influence, the gland cell would be enabled to draw large quantities of fluid from the vessels, that seems to me to be asking a little too much. If, however, under nervous influence a stronger irrigation stream is produced by the capillary wall, we might look upon the increased flow of lymph as an adequate stimulus to the gland cell. The gland cells need not now be looked upon as simple filters; the hypothesis allows them to carry on independent activity.

Further, the objection against the prevailing theory, that nerves are assumed where they cannot be found, becomes weightier from year to year, with the increase of methods and of the number of investigators, and even if such nerves should some day be found, the question still is not answered. What is the function of the nerves supplying so abundantly the capillaries of the glands (and the muscles)? What is the purpose of these fibres of the chorda tympani that do not go to the gland cells but to the capillaries?—*Cleveland Medical Gazette*.

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*Remember the A.M.S. meeting at Ithaca Aug. 21, 22, 23.*

## On the Use of Colored Light in Microscopy.

BY ARTHUR M. EDWARDS, M. D.

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For several years, indeed since 1865, I have felt that it is a fact not sufficiently appreciated by microscopists in general that the clearness with which an object can be seen depends much more upon the character of the illumination than upon the intensity of the light derived therefrom. Color is vastly more important than brilliancy. It is a common mistake to suppose that if an extremely powerful mode of illuminating the object viewed by means of the microscope be obtained that an improved definition must necessarily result. But the fact is, on the contrary, that a feeble beam, if it be of the proper color, will enable more to be seen than if a bright light of an improper tint be used. In 1871, I had a conversation with Mr. Charles Spencer, the celebrated optician, on the subject when he detailed to me the results he had arrived at during the testing of microscopic lenses and which were confirmatory in a very striking manner of my experiments and the theory I had formed for myself working independently during the preceeding years. I shall not endeavor to detail all the various experiments I undertood but shall briefly state what led me towards these investigations and the summary of the results I arrived at.

In the year 1865, I was engaged in experimenting on the obtaining of photographic representatives of microscopic objects, more particularly the Bacillariacæ, and this led to my endeavoring to ascertain the best apparatus to be made use of in arriving at the desired results. Of the mechanical part of the problem, namely respecting the microscope irrespective of the various lenses employed as well as the camera made use of I shall say

nothing at the present time as it does not bear directly on the matter at issue. But observing that hitherto all microscope objectives had been so corrected that the chemical and visual foci did not correspond in position and that if I wished to take photographs with the lenses at my command I must do as others had done before me; namely, search for the chemical focus of any given combination by taking a series of negatives until I had the point at which the best picture could be obtained, I came to the conclusion that the subject warranted investigation. I thereupon consulted with Mr. William Wales and put the question to him as to whether he could not make a lens specially corrected for photography; namely, one in which the chemical and visual foci would correspond. In the meantime I turned my attention to the further examination of the matter and put to myself this question—supposing such a lens made, would its definition be superior or inferior to those then in use? And to test this matter I decided to take such lenses as I had or could procure and use only or almost only the chemical rays that passed through them and then ascertain if such a lens would be available for working purposes.

I find in my memorandum book for October, 1865, the following record: "Having nearly two years since made several experiments from which I deduced certain inferences with reference to the character of the illumination used when resolving fine-lined objects, I made some more today. My first experiments were these: I have two objectives 1-5ths, one *a* defines pretty well, *b* much better, same power and angle. Why is this?

A. I put on *a* with *B* ocular, Amphipleura, Cuba, a fixed angle of oblique light. I did not see markings. If I place a blue glass anywhere in the path of the ray I see lines.

B. I put on *b* in exactly the same circumstances and

see lines. I place a yellow glass anywhere in the path of the ray. The lines disappear.

C. I put on *b* with day-light and I see lines ; with light from petroleum oil they disappear.

D. I get the lines with greater obliquity of illumination with petroleum light, but with gas light they disappear.

These had been my experiments up to date. Now I tried the spectrum from a flint glass prism in the afternoon when there are the least actinic rays. did resolve in the blue ray and did not anywhere else in the spectrum. The light at the same time was very faint. In the yellow ray the hexagons became strongly marked lines showing there was more light but not so much defining power. In the red ray all was confusion. Using spectrum I could resolve certain objects in the blue ray with a 1-5th. I could only do with a 1-15th with the ordinary light. Dr. R. K. Browne having told me he could resolve the *Amphipectura pellucida* when mounted dry, uncovered on mica not on glass, I took two drops from the same bottle (Moran Lake 1865, R. C. G.) of *Navicula rhomboides* and mounted on glass and mica uncovered, dry. Using spectrum in the blue ray I hexagonized with a 4-10th only to be done in ordinary light with a 1-15th. I tried the spectrum from a gum copal prism also but it was so small and faint from defective polishing, that no different results were arrived at.

A few days back I was taking a photograph and used a very faint petroleum oil lamp in my dark room ; it was behind the bath and preparing the plate. I removed it only twice from the bath and then introduced it again very quickly so that it was exposed to the light of the lamp only a very short time, yet there was a picture of the dipper on the plate taken by the light of the lamp."

"October 21st, 1865. On my S. and B. Educational

Stand I tried their common 1-4th,  $75^{\circ}$  without correcting collar; mounted *Navicula rhomboides* on quartz, saw transverse lines with dull blue daylight and very moderate oblique light. At night with more oblique light and candle light saw longitudinal lines and with gas light and still more oblique light saw lines."

Continuation of experiments on actinic ray, May 2, 1866. To day being dark and rainy I thought it favorable to try the actinism of the light of a petroleum lamp. With my  $1\frac{1}{2}$  inch objective Wales and B ocular, Zentmayer, took three negatives of a transverse section of Nuphar stem as follows.

A. 27.5 at 10 A. M., 5 minutes exposure, good.

B. 57.5 at 10 A. M., 8 minutes exposure, good.

C. 25. at  $10\frac{1}{2}$  A. M., minutes exposure, over exposed, showing the large amount of actinism in the light of the petroleum lamp. The large silvered reflector was used behind the lamp, the lamp itself up close as possible to the object and the bull's-eye condenser between it and the object, so that there were four thicknesses of glass besides the objective and ocular (1 chimney, 2 bull's-eye, 3 slide and 4 cover) and balsam between the source of the light and the sensitive plate."

This is all I have in memoranda in my record book but there are many other experiments which I remember and they were carried on for several years as I got a chance up to the present time. I now have to record what they have resulted in.

I make a slide of mica colored blue with aniline blue and this slide I place in the path of the illuminating beam of light for the microscope. This is a true actinic slide, but a slide can be made of glass also. The color is put on by means of a varnish of gum. Thus or any other colorless varnish. A slide can be also made of mica but this scratches easily. Besides the actinic slide



I have described, a slide colored with aniline red, green, yellow or any other color can be made.

## List of Exhibits at the XIth Annual Soire of the Washington Microscopical Society.

[At National Rifles Armory, May 15, 1895.]

**PATHOLOGICAL SPECIMEN,** *Dr. G. N. Acker.*

**SELECTION OF DIATOMS,** *Hon. A. A. Adee.*

**COMMON FORMS OF DISEASE-PRODUCING BACTERIA :** Bacilli (tubercle and Kelbs-Löffler.) (Spirilli cholera,) *Dr. W. W. Alleger.*

**SECTION OF KIDNEY.** Interstitial nephritis, *Dr. E. A. Balloch.*

**INSECTS.** Section of human eye (pathological.) Micro-photograph. Miscellaneous, *Mr. Henry H. Brown.*

**STEM OF CLEMATIS VIRGINIANA,** *Dr. C. T. Caldwell.*

**ELECTRIC SPARKS,** *Mr. F. T. Chapman.*

**ANATOMY OF HONEY-BEE.** Section of lilac, *Mr. P. C. Clafflin.*

**SECTION OF DUODENUM.** Showing Brunner's glands, *Dr. C. R. Clark.*

**BLOOD-CORPUSCLES** (human and reptilian,) *Dr. A. B. Coolidge.*

**POND LIFE,** *Dr. H. A. Dobson.*

**CIRCULATION OF BLOOD,** in tail of fish. Brazilian chalcedony (by polarized light.)

**SELECTION OF MOSSES,** *Mr. H. H. Doubleday.*

**CRYSTALS BY POLARIZED LIGHT,** *Mr. Oscar C. Fox.*

**COMMON FORMS OF DISEASE-PRODUCING BACTERIA :** Staphylococci (Staphylococcus pyogenes aureus.) Streptococci (Streptococcus pyogenes,) *Dr. E. A. Gibbs.*

**A COLONY OF VORTICELLA,** *Mr. John Grinstead.*

**TRICHINA SPIRALIS,** *Dr. H. H. Hawchurst.*

**SECTION OF CEREBELLUM.** Showing ganglion-cells of Purkinje, *Dr. H. L. E. Johnson.*

**SECTION OF SKIN.** Showing sweat ducts. Section of scalp, *Dr. D. S. Lamb.*

**HUMAN LIVER.** Human lung, *Dr. J. Melvin Lamb.*

**HUMAN EMBRYO.** Human bone, *Dr. Collins Marshall.*

**BONE IN STAGE OF DEVELOPMENT,** *Dr. F. E. Macey.*

**CIRCULATION OF BLOOD.** In gills of newt, *Mr. L. M. Mooers.*

**INTESTINE OF RABBIT.** Showing injection of blood and lymphatic vessels, *Dr. V. A. Moore.*

**SECTION OF SPINAL CORD.** Bouquet of butterfly scales, *Dr. Robert Reybu rn.*

**TUBERCULAR LYMPH GLAND.** Showing giant cells ; also waxy degeneration, *Dr. C. W. Richardson.*

**ANTHRAX BACILLI** In blood of guinea pig, *Dr. H. A. Robbins.*

**LUNG.** Injected. Stomach. Foot. Embryo (five weeks,) *Dr. H. W. Rollings.*

PARASITIC INSECTS, *Mr. W. E. Schneider.*

POND LIFE, *Dr. W. H. Seaman.*

SECTION OF HUMAN EYE, *Dr. D. K. Shute.*

LUNG. Broncho-pneumonic tubercle, *Dr. J. T. Sothoron.*

POLARIZING CRYSTALS OF MUSHROOM, *Dr. Thomas Taylor.*

ARRANGED BUTTERFLY SCALES. Design, bird, butterflies and flowers,  
*Mr. J. M. Yznaga.*

#### OFFICERS FOR 1894-'95.

Dr. W. W. Alleger, President ; Dr. Collins Marshall, Vice-President ;  
Dr. F. E. Maxcy and Mr. L. M. Mooers, Secretaries ; Dr. E. A. Balloch,  
Treasurer.

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### EDITORIAL.

**The Ithaca Meeting.**--Commendable activity is being displayed by those having in charge the local arrangements for the meeting of the Microscopical Society next August. Their circular which was printed in full in a recent issue of the Journal has already appeared in most of the pharmaceutical, medical, botanical, and zoological journals of the United States. This widespread publicity can scarcely fail to attract new members to the society and what is of more importance just now arouse the enthusiasm of the old. Inquiries regarding conditions of membership are, in fact, already coming in as a result of the first announcement ; and many encouraging letters have been received from members.

There is to be as we understand it another circular issued early in July, which will contain titles of papers and other details not in the first.

The exhibition of microscopes and microscopical apparatus will attract both ways. It will bring dealers in these goods to the meeting and thereby secure their hearty support to the society and will at the same time draw those who may wish to see the best and latest microscopical outfits. A large local committee has been formed consisting of representative business men of Ithaca and Professors in Cornell University. Their attention will be given to the entertainment of this particular society. Probably no better place could be selected for holding a meeting than in the laboratories of some well-equipped University. To prove this, it is only necessary to call attention to the

ample and commodious accommodations at Madison two years ago. It will afford the members particular pleasure and profit to visit the laboratories in the various departments of Cornell University, to study their appointments, and to meet on the ground some of the men who work in them.

No place of summer resort or residence is more popular than the lake region of central New York, and none of the lakes presents more charms than Cayuga. Ithacans are proud of their city and their University and will take pleasure in entertaining the members while there.

The efforts being made by those interested in entertaining the members, entitle them to the hearty co-operation of all interested in microscopical science and particularly the members of the American Microscopical Society. The conditions seem better than usual for successful meetings.

The "Proceedings" of 1894-'95 opened with an October number, seven months behind time. We do not hear that the second number is yet in hand and fear there may be little or no matter ready for it. Do not pretend to the Postoffice Department that you are entitled to second class rates, Mr. Secretary, when you are not! No occasional publication is entitled to be sent through the mails at pound rates. Neither can annuals or semi-annuals claim that privilege. Issues cannot be over three months apart to go in that way. Sending your October number at pound rates seven months behind the preceding issue was illegal and improper. Unless your next number is out within 3 months of the last one, walk up to the stamp window and buy your stamps just like the Boston Society of Natural History, the Franklin Institute and the others who issue occasionals.

**The Jersey Biological Laboratory.**—This place was organized in 1893, by Sinel and Hornell and attained a great reputation in England for its slides. As a mutual accommodation, we have been running an advertisement for them since last August and have received and forwarded a good lot of orders from new subscribers. Owing to the withdrawal of Mr. Sinel last winter, work and correspondence was temporarily interrupted and some of our subscribers have had to wait for their slides provokingly long, but the goods are now arriving and

everybody is so happy over the excellent workmanship and low prices, that patience is being fully rewarded. If any who have sent money to us for slides have not received them, please send word at once.

The Quarterly Journal of Marine Zoology is also being resumed by Mr. Hornell alone and we are in receipt of the March number. It contains three full page plates and seven original articles. To show its character we will next month reproduce an article from its pages. We take subscriptions, postpaid, at \$1.00 per annum.

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### BACTERIOLOGY.

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**A New Laboratory.**—A bacteriological laboratory is to be established in Philadelphia under the supervision of Dr. Bolton, of Johns Hopkins university, as city bacteriologist. Every facility for experiment will be furnished. The scope of Dr. Bolton and his assistants will be wide. There will be diagnostic tests for consumption, the germs of all contagious diseases will be observed, the drinking water will be examined daily to see whether it is polluted, samples of the city milk supply will be placed under the microscope, and blood serum for the cure of diphtheria and rabies will be made. Culture tubes will be sent from the municipal hospital to the laboratory where they will be examined and the nature of the disease reported upon.

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### PERSONAL.

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**Professor Bleile**, of the Ohio state university, has been conducting a series of experiments upon animals which lead him to the conclusion that an electric shock of sufficient intensity to cause death results in a contraction of the arteries, so that they refuse to perform their functions. This throws the blood from the veins upon the heart, and virtually drowns the operation of that organ. If this is so, death occurs without real injury to any organ, and if some means could be discovered by which the arteries could be dilated after the shock, Dr. Bleile thinks it might be possible to resuscitate a person who has been apparently killed by an electric discharge.

**Williard Winfield Rowlee** whose portrait appears as a frontispiece to this number, was born in Fulton, N. Y., in 1862, and is therefore 33 years of age. In 1888 he took the degree of Bachelor of Letters (B. L.) and in 1893 that of Doctor of Science (D. Sc.) in Cornell University. He was called at once to become an assistant in the Botanical Department and is now Assistant Professor of Botany.

Professor Rowlee is a man of strong physique, vigorous in the extreme both mentally and physically, and a born botanist. He is thoroughly in accord with the modern botany and has made some very honorable contributions to the advancement of knowledge in his chosen field.

As a teacher, Dr. Rowlee is so enthusiastic, kindly and pains-taking that he wins the good will of his students and inspires them with his own earnestness. He has those qualities of good fellowship and regard for others that among his colleagues and peers every one is his friend.

With vigorous health, a happy home, many earnest and loyal students and an honorable position in a great university, the future seems very promising for an honorable and prosperous career.—S. H. G.

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## MICROSCOPICAL SOCIETIES.

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### Lincoln Microscope Club.

*January 30, 1895.*—The Treasurer's report was deferred till the next meeting on account of illness of Mr. Dale.

The following officers for 1895 were elected :

President, Dr. H. B. Ward; Vice-President, Prof. G. D. Sweegy; Secretary, Roscoe Pound; Treasurer, J. S. Dales; Executive Committee, Prof. B. L. Seawell, Dr. I. C. Philbrick.

Dr. Bessey called attention to some improvements made in the Reinhold-Giltay Microtome belonging to the University of Nebraska. He also exhibited a new device he has had made for marking the place of objects in slides. It is based on Prof. Gage's device, but differs in important particulars.

Among other exhibits were: Prof. Seawell, a preparation of detached nerve substance from the spinal chord; by Dr. Ward,

Diplozoon, a parasite in which two individuals unite to form a hermaphroditic individual; by Mr. Hall a parasitic trematode from the intestine of a snipe, reconstructed graphically from sections; by Dr. Philbrick, slides of carcinoma.

Dr. Ward explained some methods of graphic reconstruction of organs from sections.

Mr. Pound called attention to some of the plates in Micheli's *Nova Genera Plantarum* (1729,) showing some remarkable results with the microscope at an early date.

### Washington, D. C.

May 15, 1895.—In lieu of the May meeting of the Society the annual reception was given at the National Rifles Armory, G street, between 9th and 10th streets northwest.

The committee of arrangements provided tables and lamps, and care for microscopes sent to the hall the day of the reception. Microscopes thus sent are to have a tag attached giving the name of the exhibitor for whose use they are intended.

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### NEW PUBLICATIONS.

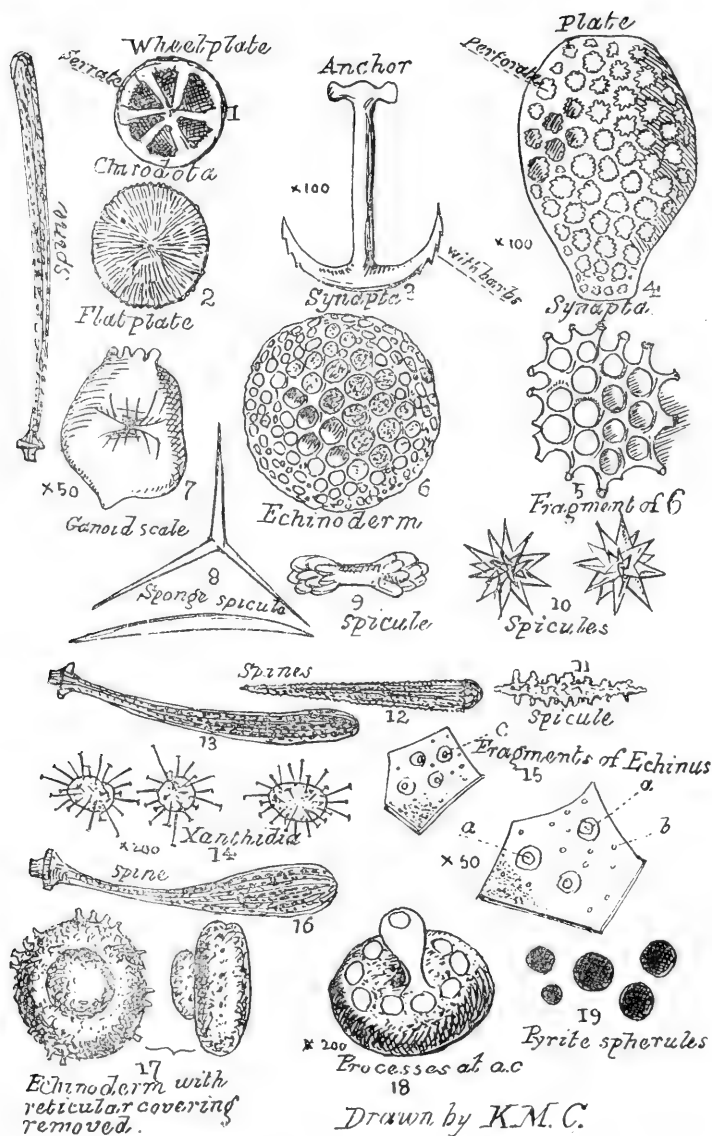
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*A Manual for the Study of Insects* By John Henry Comstock. Ithaca, N. Y., 1895. With 797 illustrations and 7 full page plates. Octavo, cloth, \$3.75.

This is a work which teachers and all learners in Entomology have been needing for many years. This new book must supersede all previous works by its most practical methods of teaching. The groups of insects have been fully characterized, so that their relative affinities may be learned; and much space has been given to accounts of the habits and transformations of the forms described. In the matter of nomenclature, hitherto a serious obstacle, the author removes this by making a serious study of the homologies of the wing-veins, and by applying the same terms throughout the work to homologous veins. The result is that the student is required to learn only one set of terms; and in applying these terms there will be brought to his attention in a forcible manner the peculiar modifications of structure characteristic of each order of insects.

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MICROSCOPIC FOSSILS OCCURRING IN TERTIARY  
MARL STRATA



# THE AMERICAN

## MONTHLY

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### Notice of Microscopic Fossils Occurring in Tertiary Marl Strata.

By K. M. CUNNINGHAM,

MOBILE, ALA.

[With Frontispiece.]

Having recently had occasion to make a micro-analysis of some samples of a calcareous marl from a deposit occurring on the Chickasawhay River near Red Bluff Station, on the line of the Mobile and Ohio Railroad, in Clarke County, Mississippi, I was agreeably surprised, during the examination, by the character and contents of the material. It also proved to be of more than ordinary interest, and the results of its study I have deemed as of sufficient importance to be placed upon record for the benefit of students of the microzoa. The marl offered itself in two conditions: one as an earth, friable and minutely granular in structure, and ochreous in color, composed almost entirely of microscopic foraminiferal shells; the number of species included therein probably reaching fifty or more. These are essentially the same species as are of record as occurring in the cretaceous marls of New Jersey, and which have lately been listed and published in the Journal of the New York Microscopical Society by Anthony Woodward, Ph. D. The other sample was a very tough and blue-green clay.

Apart from the foraminifera noted in the other mater-

ial, I was enabled to isolate quantities of the strange, rare, or curiously shaped bodies known as Xanthidia, and which organisms are almost invariably found, when examined with higher powers, in thin flakes of the British flints; but in this marl they exist in their isolated or free state, and from it they may be removed by selection to any required extent, and can then be viewed in every aspect by suitable manipulation.

In a reduction of samples of the tough greenish-blue marl clay, I was enabled to find the anchors, shield-plates and wheel-plates of fossil Echinodermata (Holothurians) such as characterize the recent or living species of Chirodota and Synapta of the Mediterranean Sea; also fragments of the ambulacral plates of minute Echini; and minute spines corresponding in form to the recent Gulf species of Spatangus.

There were also minute Echinodermata (?) having an ornate external glass-like reticular covering which is very fragile and seldom found intact, within whose internal portion is situated a core of sponge-like texture which, while preserving the oblong spheroidal shape, is usually seen divested of the glassy reticular casing.

There are tri-radiate sponge spicules, characteristic of the marine genus of sponges, Grantia; stellate spicules, characteristic of the genus Tethya; spicules resembling those of recent Gorgonia; together with multi-lobate spicules, and, finally, minute ganoid scales of about 1-50 inch diameter.

The minute fossil remains in every case are composed of carbonate of lime, all silicious fossils being absent, as determined by acid tests; but the foraminifera were in many instances altered or changed to mineral pyrite, or to beautiful casts of a deep green hue.

Having thus found certain fossil organic remains of Eocene Tertiary age, which have their modern or exist-

ing equivalents in the various tropical seas, the student would naturally turn to the question of their agreement or correspondence or lack of correspondence in certain anatomical relations or bearings. By suitable comparison it will at once be seen that there are traces of dissimilarity between fossils of the Mississippi marl and the recent species of Holothurian epidermal structures. The anchors occurring in the marl have barbed prongs, and the shield-like plates are more numerously perforated with holes having serrated edges, while the wheel-plates in their dry state exhibit a webbed space uniting the six spore-like rays which radiate from center to marginal rim, the inner edge of the rim showing a serrated arc, thus forming a plate-like surface. But in such anchors of recent species as I have been enabled to examine, I found no trace of barbs on their prongs, and the shield-like plates had few perforations, and those were quite large. They had an open slender skeleton of meshes. The wheel-plates do not clearly indicate any other structure than that of six radiating spokes without any discernable web uniting them.

Those who are familiar with the beautiful and elaborate rosette preparations of diatoms, anchors, wheels and shields of *Synapta* and *Chirodota*, and stellate spicules, as prepared and sent out by noted European artists in this class of work, for the delectation of American patrons, will appreciate the use made of these little adornments of the Holothurians (sea cucumbers), which are gathered from the bays of the Indian Ocean and Mediterranean Sea and elsewhere. These are comparatively unknown in their unprepared state in the United States, through the educating medium of mutual exchanges of microscopical material.

And while on the subject of preparations containing arranged Holothurian plates, etc., I will state that the

anchors, shields and wheel plates of carbonate of lime, in a number of rosette preparations in my possession have been gradually dissolved away in the balsam leaving the merest traces of their former outlines after eight years of inclusion in the slides, which shows that the beautiful and expensive rosette preparations of this character are not durable or permanent.

The sponge and other spicules, anchors, shield and wheel plates, Echini, etc., of the Mississippi marl are all polariscope objects, and the stellate spicules by themselves act as analyzers, independent of the nicol prism being placed above the slide to develop the color effects.

I have prepared to accompany this paper a plate or sketch, with numbers and names of the objects illustrating the various interesting fossil bodies of microscopic interest found in this American calcareous marl deposit in the hope that it may add interest to the perusal of the text. It appropriately transpires in conjunction with this subject that in "Carpenter on the Microscope" there appears a plate containing a somewhat similar showing of micro-organic remains derived from the white mud of the Levant, or from the harbors of the Eastern end of the Mediterranean Sea.

The circular scales or plates indicated by the figure numbered 2 in plate, polarize with brilliancy and suggest the circular crystals of Salicine. The marine calcareous marl stratum offering this variety of interesting objects is distant from the Gulf of Mexico, eighty miles in a northerly direction, and the surface or superficial formation covering the marl area from that point to the Gulf is known as the Lafayette formation, which consists of silicious sands and quartz pebbles without any marine fossils, but fossils of petrified vegetation alone, chiefly of the Coniferæ.

## Microscopical Technique Applied to Histology.—IX.

[FROM THE FRENCH OF RENÉ BONEVAL.]

*(Continued from page 344, November 1894.)*

Sections of the same nerve made after the action of ammonia bichromate, gum and alcohol, should be differently stained. Some, to show the laminated sheaths and the connective tissue of the nerves, should be stained by hæmatoxylin and eosine, and mounted in balsam after dehydration and clearing by oil of bergamot. Others should be stained by Weigert's method, which specially stains myeline. Follow carefully these directions:

Sections are made from the nerve fixed and hardened by ammonia bichromate until it is brown, *not* green, and kept for a long time in alcohol. For 24 hours leave the sections in some of the following solution in a warm place: saturated solution of acetate of copper, 20; filtered water, 20. Remove them to Weigert's hæmatoxylin raised to 35° or 40° C. (hæmatoxylin, 1 part; alcohol, 10 parts; water, 90 parts; saturated solution of carbonate of lithia, 1 part). When stained (in about 4 hours), wash in water and transfer to the following solution: borax, 2 grms.; red prussiate of potash, 2.50 grms.; water, 20 grms. Leave them here for from one-half to one hour. It is well to ascertain the degree of coloration with a low power. Wash in water, mount in balsam.

To study by sections the fibres without myeline, cut transverse sections of the pneumogastric of the frog, the rabbit or the dog, after fixing by osmic acid, hardening by alcohol and gum; stain in alum carmine, mount in glycerine.

## SPINAL CORD.

*Nerve Cells.*—A piece of the spinal cord of the ox,

from 1 to 2 mm. thick, is put to macerate in the  $\frac{1}{3}$  alcohol. In 24 hours remove, by the point of the scalpel, a bit of the gray substance and shake it in a test tube containing 15 cc. of distilled water. Shake violently to separate the elements, and add 1 cc. of picro-carmin. When stained (generally in one hour), add 1 cc. of 1 per cent osmic acid. Leave it for 24 hours, and when the elements have settled to the bottom, pour off the supernatant liquid and replace it by distilled water. Renew many times by decanting. To put a drop of the deposit on a slide is all that is needed to obtain a beautiful preparation of the nerve cells magnificently colored. To make permanent preparations, when the cells have been well washed and the liquid poured off, add 5 cc. of distilled water with 1 c. of glycerine slightly colored with picro-carmin. Leave the tube open so as to concentrate the liquid by evaporation, and the next day put a drop of the mixture on a slide. To apply the thin cover without washing away all the cells is a delicate operation. To accomplish this, mount in glycerine jelly. Place a bit of the jelly on a warm slide, and, when liquified, add in the centre a small drop of the deposit of nerve cells, mingle together with a needle and cover.

*Nerve Fibres.*—To separate the nerve fibres of the cord is a delicate operation, to be done only by Ranvier's method of interstitial injection. Insert the needle of a hypodermic syringe, charged with 1 per cent osmic acid, into the antero-lateral column of a perfectly fresh spinal cord from a dog, and gently inject. Remove a small piece with a razor and dissociate it on a slide with water. Stain in picro-carmin; mount in glycerine.

*Sections.*—Of the many methods, we describe only those of use to the beginner.

*Fixing and hardening.*—Take a portion, not longer than one centimetre, from the cervical region, one from

the dorsal, one from the lumbar. Let the cut surfaces be perpendicular to the long axis of the cord. Place them in 300 or 400 grms. of Erlicki's fluid, made thus:—Bichromate of potash, 2 grms.; sulphate of copper, 0.50; water, 100. At ordinary temperature, hardening will be effected in from 10 to 12 days; in an oven at 37° C., in 4 or 5 days. It is well to renew the fixative once or twice. Wash in water for 24 hours, then place in alcohol.

*Staining; imbedding.*—Imbed a piece a half a centimetre long in celloidin. Place the sections in alcohol; stain by Wiegert's method; mount in balsam.

*Medulla oblongata; cerebrum; cerebellum.*—Fix, stain and imbed as already described for the cord. The convolutions of the cerebrum and of the cerebellum furnish the following preparations:—(1) Dissociate the ganglionic cells after maceration in the  $\frac{1}{3}$  alcohol. (2) Section after hardening in Erlicki's fluid. Stain in the alcoholic boracic carmine, or by Weigert's method; imbed in celloidin; mount in balsam.

#### DIGESTIVE APPARATUS.

*Mucous membrane of the mouth and lips.*—Section, after fixing by alcohol and hardening by alcohol and gum. Stain in picro-carmin, cover, replace the staining fluid by glycerine.

The lamellar cells forming the most superficial layer of the buccal epithelium may be easily isolated. Scrape the inside of the cheek with the finger nail, spread the cells on a slide in a drop of saliva, expose to osmic acid vapor, stain in picro-carmin.

*Mucous membrane of the tongue.*—Beautiful preparations may be made by fixing and hardening pieces in alcohol and gum. Section, stain in picro-carmin, mount in neutral glycerine or with a little picro-carmin added.

*The papillæ of taste.*—Examine the foliated or the calciform papillæ on the posterior lateral and the posterior borders of the rabbit's tongue. Select a small piece well freed from the surrounding tissues; put it in 1 per cent osmic acid. In 12 hours wash in water for 24 hours; harden by gum and alcohol. Section, stain in alum carmine, mount in glycerine.

Impregnation by gold gives fine preparations. Lemon juice, ten minutes; 1 per cent chloride of gold, forty minutes. Reduce in acidulated water as directed for nerve endings in muscles.

*Mucous membrane of the pharynx.*—Dissect out one portion from the upper, another from the lower part of the pharynx. Spread them in a saucer of 95° alcohol, harden in gum and alcohol. Section, stain in picro-carmine, mount in glycerine.

The frog is most useful for the study of ciliated epithelium of the pharynx. Scrape the pharyngeal wall with a scalpel and place the result in a drop of aqueous humor (or even of water), cover, examine with a high power.

To make a permanent preparation of the vibratile cells, rapidly separate the material obtained by scraping the pharyngeal wall, expose for 10 minutes to osmic acid vapor, stain in picro-carmine.

The tonsils should be studied by the method described for lymphatic glands.

*The œsophagus.*—As man's œsophagus can seldom be had sufficiently fresh to make good preparations, select that of the dog, rabbit or rat. Slit open the organ, cut out a piece and spread it in a saucer of very strong alcohol for 24 hours; harden in gum and alcohol. Make transverse and longitudinal sections. Stain in picro-carmine: mount in glycerine with a little picro-carmine,



Fix another piece by ammonia bichromate, 2 per cent, for 8 days; wash several times thoroughly; harden in gum and alcohol, section, stain in hæmatoxylin and eosine, and mount in balsam.

The rabbit's œsophagus affords excellent material for studying the nerve endings in the muscle. Place a ligature at the lower part, fill the tube with fresh lemon juice. In a few minutes wash lightly and replace the lemon juice by a 1 per cent chloride of gold solution; tie, to keep the tube slightly distended; cut out the part beyond the two ligatures and place for 20 minutes in a bath of gold chloride. Slit the segment of œsophagus, put it for 24 hours in the  $\frac{1}{2}$  acid. It is very easy to strip off a shred of the muscular layer and to mount it flat in glycerine.

*The Stomach.*—In that of the frog, study the epithelium lining the gastric mucous membrane. Open the stomach and macerate it in the  $\frac{1}{3}$  alcohol. In 24 hours, scrape the inner surface with a scalpel, spread the product on a slide in a drop of the  $\frac{1}{3}$  alcohol, add picro-carmin and mount in glycerine by the partial desiccation method.

*Sections.*—Remove the stomach with an end of the œsophagus and two or three centimetres of the small intestine attached. Dilate the stomach by injecting through the œsophagus the fixing fluid, after tying the small intestine. Tie the œsophagus and put the whole in a bottle of the fixing fluid. Absolute alcohol or osmic acid are useful as fixatives. Section after 1 hour in absolute alcohol. If osmic acid be used, let it act for half an hour, wash for one or two hours, harden by gum and alcohol, section, stain by alum carmine, preserve in glycerine.

*Stomach of a mammal.*—Select that of a dog, of a cat or of a rabbit. Remove a portion from the cardiac

region, near the lower extremity of the œsophagus, from the greater curvature and from the pylorus. Spread out these, which should not be more than one centimetre in diameter, and immerse in the fixing liquid in a saucer or when attached to a cork. Strong alcohol, osmic acid or the ammonia bichromate may be used according to the special technique to be followed. Complete the hardening, if necessary, in gum and alcohol. Section, stain in picro-carminé, quinolein blue (after alcohol), Bœhmer's hæmatoxylin (after bichromate), and alum carminé (after osmic acid).

#### THE SMALL INTESTINE.

This presents an epithelial lining, a glandular epithelium, a system of coats, vessels and nerves.

*Lining of epithelium.*—Take a loop of the small intestine of the frog or of the rabbit. Slit it open lengthwise and macerate it for 24 hours in the  $\frac{1}{3}$  alcohol. With a scalpel scrape the inner surface and spread the result on a slide in a drop of the alcohol. Stain in picro-carminé, mount in glycerine slowly run under the cover to displace the staining fluid. To prevent the shrivelling of the cells by the glycerine, expose for ten minutes to the vapor of osmic acid before staining and mounting. If, after removing the cells in the  $\frac{1}{3}$  alcohol, we add a very weak aqueous solution of aniline blue, we can see the progress of the staining, the deeper layer of cells taking the color, while the nucleus, the protoplasm and the superficial layer are scarcely tinged.

*Glandular epithelium.*—The glandular element is represented by Brunner's and by Lieberkuhn's glands. The former are to be studied in the sections near the pylorus. Fix by alcohol, stain with picro-carminé, sections cut by the gum and alcohol method.

*The glands of Lieberkuhn.*—Dissociate the glandular

elements by macerating a fragment of the small intestine in the  $\frac{1}{3}$  alcohol. Brush off the lining epithelium, then strongly scrape the same surface by the scalpel. Spread the result in a drop of the  $\frac{1}{3}$  alcohol, stain in picro-carmin, mount in glycerine.

*To be continued.*

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### Morphodiscs, Coccoliths, and Discoliths.

BY ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

When I noticed the Discoliths in the clay beds of Woodbridge, N. J., in the American Journal of Science, June, 1883, I found they were not known to microscopists generally, although they were to geologists who use the microscope. They were pretty well known, especially as Huxley's paper on them, in the appendix to Capt. Dayman's Report of Soundings taken in H. M. S. "Cyclops," 1858, made them farther known. The microscopical fauna of the Cretaceous in Minnesota, with additions from Nebraska and Illinois, by A. Woodward and B. W. Thomas, in Vol. III of the Final Report of the Geological and Natural History Survey of Minnesota, 1893; and Dallinger's Carpenter on the Microscope, VIIth Ed., 1891, makes them pretty well known, but E. H. Schwartz's paper on Coccoliths, in the Annals and Magazine of Natural History for 1894, for which I am indebted to him, makes them clear and distinct, so may serve as a text to what I have to write about them.

Their bibliography is rather extensive, especially when we consider that they have been known only a few years. But they are small and require nice manipulation to bring them out, and, besides, it is doubtful exactly what they are, although evidently organic and present now as in the chalk of the cretaceous. They

seem to range in the lowest orders of life, where the animal and vegetable come together, in fact in the Protista.

They were first discovered by Ehrenberg in 1836, in chalk, and described as inorganic bodies. According to him, they were flat bodies having concentric rings on their surface, and in 1854, in the *Mikrogeologie*, he described them as "chalk morpholiths." So that morpholith is the first name they go by. Huxley and Wallick showed these bodies occurring in the chalk to exist now in the sea, and the former called them "for convenience" coccoliths. He also distinguished two forms, one simple the other double, and called them discoliths and cyatoliths. Haeckel, in 1870, called them monodiscs and amphidiscs. These two observers consider them to be crystalloids of a giant *Amœba*—*Bathylus*. Murray and Buchanan proved *Bathylus* to be gelatinous calcium sulphate precipitated by the alcohol in which the soundings were preserved. They had hitherto not been considered organisms themselves, but now they were supposed to be so. Barrois and others stoutly contested the idea and Harting considered them to be mere mineral concretions. Gumbell and Carter supposed them to be connected with the reproduction of calcareous algæ. Wallick first noticed coccospheres and considered them to be nothing else than embryonic foramenifera; the coccoliths were calcareous spicules. Sir Wyville Thompson noticed that threads hung in sea water over night were full of coccoliths in the morning. So that these organisms were found at the surface and in the depths of the ocean. *Bathylus*, as its name signifies, was found in deep water, so it can be seen that their place in a kingdom, if such can be established, cannot be called certain; but, if the Protista come in between the animal and the vegetable, they will be placed there.

To describe the discoliths: They are minute oval bodies, one twenty-one hundredths of an inch in their longest diameter. In their centre is a bright highly refractive body called by Hæckel the "Centralkorn," which is usually slightly, but frequently also markedly raised above the surface as a knot when seen from the side. In the flat area surrounding the central point, Hæckel's "Markfeld," there are two or four slightly raised points similar to the central one in it, but not nearly so much differentiated. Round the "Markfeld" is the "mark ring," which is a refractive ring of calcite, forming a thick rounded rim to the little plate, and in the older examples is slightly beaded. Hæckel then notices that this surrounds itself with a granular ring, and finally with another brightly illuminated outer ring. So that it is an extremely small object with a series of concentric rings on it, which are oval and marked with granulations.

What it is is doubtful, some calling it an animal and some a vegetable. What it is chemically can be ascertained approximately, being carbonate and phosphate of lime with alumina and silica. What it is geologically is doubtful, being found in the chalk and living now. That they are organic, there is no doubt, and belong to that class of beings which are marked as merging on the vegetable on one side and the animal on the other, in fact Protista.

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**John A. Ryder.**—Perhaps the best memento we can furnish to this naturalist who died March 26, 1895, is to print a description of his Microtome which will be found on another page. Professor Ryder was born near London, Pa., in 1852. Since 1886 he has been professor of Embryology in the University of Pa. He wrote extensively and was an opponent of Weismannism. His early death was perhaps due to too intense application to study.

# Classification of the Radiolaria: Key to the Species of Barbadoes.

By REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

*Continued from p. 85, March, 1895.*

## 79. ZYGOCIRCUS.

Ring without edges; 10-15 spines.....polygonus  
Ring with interrupted edges 10-20 or more spines.....butschlu

## 80. DENDROCIRCUS.

Eight-twelve branched acute spines ; numerous smaller spines...barbadensis

## 81. CORTINA.

Three forked horizontal spines ; 3 divergent forked feet.....furcata

## 82. STEPHANIUM.

Rings thorny ; thorny apical horn ; 4 branched feet.....tetrapus

## 83. SEMANTIS.

Sagittal ring ovate, with 4 pairs of branched spines.....spinescens

## 84. SEMANTRUM.

Sagittal ring nearly semi-circular thorny.....mulleri  
Sagittal ring circular, smooth.....sphragisma  
Sagittal ring triangular, with branched thorns.....butschlu

## 85. SEMANTIDIUM.

Sagittal ring elliptical, with 3 pairs of branched spined.....haeckelii

## 86. CORTINISCUS.

Sagittal ring with branched thorns ; basal ring with 4 gates.....tetrapylaris

## 87. STEPHANISCUS.

Basal ring nearly square ; 4 feet branched.....medusinus

## 88. PODOCORONIS.

Basal ring kidney-shaped, with 3 feet.....tripodiscus  
Basal ring violin-shaped, with 10-12 feet.....petalospyris

## 89. TRISTEPHANIMUM.

Sagittal ring ovate ; frontal, violin shaped ; basal, kidney-shaped..hartwigii

## 90. MICROCUBUS.

All 12 gates simple ; all rings tuberculate.....pentocircus

## 91. TYMPANICUS.

Basal ring with 6 conical feet.....fibula

## 92. TYMPANIDIUM.

Sixteen gates, the basal kidney-shaped.....barbadense

## 93. TRIOSPYRIS.

Basal plate with 3 pores ; feet very long.....triomma

Basal plate with 4 pores ; feet club-shaped.....clavata

Basal plate with numerous pores ; feet 3-sided, dentate.....tribrachiata

## 94. TRICERASPYRIS.

Caudal foot the shorter ; feet not forked .....didicerus

All 3 feet same length ; feet forked.....furcata

## 95. TRISTYLOSPYRIS.

Feet cylindrical, long, strongly curved.....tricerus

## 96. DIOSPYRIS.

Shell thorax-shaped, smooth ; horn and feet equal.....bipes

Shell elliptical, spinulate ; horn shorter than feet.....mystax

Shell violin-shaped, thorny ; feet S-shaped.....sigmopodium

## 97. BRACHIOSPYRIS.

Basal plate with 4 large and 4 alternate pairs of smaller pores.....ocellata

## 98. DEUDROSPYRIS.

Feet cylindrical, straight, divergent.....stylophora

Feet cylindrical, more or less curved, convergent.....dirrhiga

Feet prismatic, straight, with lateral branches on edges.....bibrachiata

## 99. TETRASPYRIS.

Shell nearly cubical, smooth.....cubica

## 100. HEXASPYRIS.

Shell tuberculate ; feet bristle-shaped, short.....setigera

Shell tuberculate ; feet thick, with lateral branches.....butschlii

Shell spinulate ; feet slender, long.....articulate

## 101. LIRIOSPYRIS.

Shell nearly spherical, with slight sagittal stricture.....clathrata

Shell ovate, with sharp sagittal stricture ; horns fenestrated at base.....turrita

## 102. CANTHAROSPYRIS.

Shell tuberculate ; 2 feet larger and longer than the other.....atenchus

Shell smooth ; all 6 feet equal and similar.....radicata

## 103. CLATHROSPYRIS.

Shell nearly cubical; feet spindle-shaped .....fusiformis

## 104. AEGOSPYRIS.

Shell tuberculate; the 4-paired feet twice as long as shell .....longibarba

## 105. ELAPHOSPYRIS.

Caudal and sternal feet straight, the 2 pectoral feet S shaped.....heptaceros

## 106. TAUROSPYRIS.

Feet branched like a deer's antler .....cervina

## 107. THEROSPYRIS.

Surface covered with tubercles; feet club-shaped. ....canis

## 108. PETALOSPYRIS.

Basal plate with 2 pores; 7-9 conical feet .....foveolata

Basal plate with 3 pores; 10-12 flat feet.....platyacantha

Basal plate with 4 pores; 16-20 laminated feet.....enpetala

Basal plate with 4 pores; 20-25 conical feet .....tessaromma

Basal plate with 9 pores; 20-25 feet.....argiscus

Basal plate with 12 pores; 16-20 feet.....bellidiastrum

## 109. ANTHOSPYRIS

Basal plate with 4 pores; 9-12 slightly curved feet.....diaboliscus

## 110. CERATOSPYRIS.

Shell subspherical; spines not branched. ....echinus

Shell nut-shaped; spines branched. ....ramosa

## 111. GORGOSPYRIS.

Shell smooth; 24-30 feet shorter than half the shell .....ebrenbergii

Shell tuberculate; 15-25 feet about as long as the shell.....lamellosa

## 112. CIRCOSPYRIS.

Shell tuberculate; horn not toothed at end.....gigas

Shell smooth; horn with 3 teeth at end.....tridentata

## 113. DICTYOSPYRIS.

Basal plate with 2 pores; shell with ramified tubercles.....stalactites

Basal plate with 3 semi-circular pores; shell tuberculate .....tristoma

Basal plate with 3 heart-shaped, 2-lobed pores; shell spinulate.....triloba

Basal plate with 3 pores; shell smooth.....gigas

Basal plate with 4 pores; shell nearly cubical, smooth.....fenestra

Basal plate with 4 pores; shell nut-shaped, tuberculate.....tetrastoma

Basal plate with 4 pores; shell nut-shaped, spinulate.....spinulosa

Basal plate with 6 pores; shell nut-shaped, tuberculate .....hexastoma



## 114. ACROSPYRIS.

Shell 3-sided pyramidal ; cephalis campanulate..... pyramidalis  
 Shell spinulate ; cephalis nut shaped, very large..... macrocephala

## 115. PATAGOSPYRIS.

Shell tuberculate ; 12-15 parallel triangular feet..... confluens  
 Shell tuberculate ; 15-20 divergent lanceolate feet..... lanceolata  
 Shell smooth ; 6-9 broad feet..... stiligera

## 116. DESMOSPYRIS.

Shell tuberculate ; 15-20 feet about as long as the thorax..... anthocyrtoides

## 117. SPHÆROSPYRIS.

In centre of basal plate a rectangular cross with 4 equal pores..... sphaera

## 118. BOTRYOPERA.

Cephalis quadrilobate..... quadriloba

## 119. BOTRYOPYLE.

Cephalis trilobate ; thorax ovate..... cribrosa  
 Cephalis quinque lobate ; thorax conical..... cephalodes

## 120. BOTRYOCELLA.

Cephalis trilobate ; occipital lobe helmet-shaped..... nucula

## 121. LITHOBOTRYS.

Cephalis trilobate ; thorax with few small pores..... geminata  
 Cephalis trilobate ; thorax with very numerous small pores..... lithocorythium  
 Cephalis quadrilobate ; thorax with rather large pores..... nasuta  
 Cephalis quinquelobate ; thorax with few small pores..... ornata

## 122. BOTRYOCAMPE.

Cephalis quinquelobate ; occipital lobe helmet-shaped..... galea

Three genera were omitted in the Key to the Genera, namely :—

Cortina, Stephanium and Stephaniscus.

Cortina and Stephanium should be inserted after *Zygocircus* (p. 305, *Journal*, Nov. 1893.) and the Key should read :—

## 17. Family STEPHANIDA. One ring.

## A. Without basal feet.

Branched spines..... Dendrocircus  
 No branched spines..... Zygocircus

## B. With basal feet.

Three feet..... Cortin

Four feet..... Stephanium

Stephaniscus should be inserted after Cortiniscus (*same page*) and the Key should read :—

Four basal feet..... Stephaniscus

### 123. TRIPOCALPIS.

Shell about as long as broad; apical horn scarcely one fourth as long

as shell..... galea

Shell 1 1-2 times as long as broad; apical horn half as long as shell. tricostata

### 124. TRIPILIDIUM.

Shell elongate; about 30 longitudinal rows of small pores..... elongatum

### 125. CINCLOPYRAMIS.

Shell with 6 ribs, connected by 12-16 complete rings..... cribellum

Shell with 12 ribs, connected by 12-15 interrupted rings..... lithosestrum

### 126. HALICALYPTRA.

Six feet, 1-2 as long as the shell..... virginica

Six feet, as long as the shell, with dentate edges..... campanula

Six feet, 2-3 times as long as the shell..... ampulla

Nine feet, about as long as the shell..... novena

### 127. CARPOCANISTRUM.

Shell large, with 40-50 pores on its greatest breadth..... giganteum

### 128. PHÆNOCALPIS.

Shell subspherical, smooth; 6 feet..... ocellata

Shell campanulate, rough; 9 feet..... carinata

Shell campanulate, smooth; 12-15 feet..... flabellum

### 129. CORNUTELLA.

Shell slender, conical; pores nearly square..... stiligera

Shell wide, conical or funnel-shaped; pores circular in about 9-12 lon-

gitudinal rows..... circularis

Shell wide, campanulate; pores circular, not in rows..... mitra

Shell wide, conical; pores circular in 12-15 longitudinal rows..... clathrata

### 130. ARCHICORYS.

Shell nearly spherical; pores separated by spinulate frames..... globosa

### 131. CYRTOCALPIS.

Shell ovate; pores perpendicularly perforating the wall..... compacta

Shell nearly cylindrical; pores obliquely perforating the wall..... lithomitra

### 132. HALICAPSA.

Shell tuberculate; pores of different sizes..... prunoides

Shell spiny ; pores of nearly equal size .....pyriformis

## 133. DICTYOPHIMUS.

Shell flat, pyramidal ; feet 2-3 times as long as the shell .....craticula

Shell smooth, pyramidal ; feet 1-3 as long as the thorax.....lucerna

Shell rough, pear-shaped ; feet with teeth on edges.....hamosus

Shell smooth, pyramidal ; feet with tooth at the base.....tridentatus

Shell thorny ; feet spiny, as long as the thorax.....pocillum

## 134. LITHOMELISSA.

Cephalis with 1 horn, shell smooth ; length of joints, 4:5.....macroptera

Cephalis with 1 horn, shell rough ; length of joints, 4:2.....ehrenbergii

Cephalis with 1 horn, shell smooth ; length of joints, 5:4 .....mitra

Cephalis with 1 horn, shell papillate ; length of joints, 1:5 .....microstoma

Cephalis with 2 horns, shell rough ; length of joints, 6:5.....haeckelii

Cephalis with 3 or more horns, shell smooth ; length of joints,

4:3.....corythium

## 135. PSILOMELISSA.

Shell rough, with obliterated collar stricture .....hertwigii

## 136. SPONGOMELISSA.

Shell of dense spongy structure, with a deep collar stricture.....spongiosa

## 137. EUCECRYPHALUS.

Shell campanulate ; peristome with 10-12 spines .....campanella

## 138. LYCHNOCANIUM.

Shell smooth ; feet little divergent, about as long as thorax.....continuum

Shell pear-shaped, rough ; feet divergent, about as long as thorax .....pyriforme

Shell campanulate ; feet divergent, twice as long as thorax .....carinatum

Shell pear-shaped, rough ; feet divergent, half as long as thorax.....ventricosum

Shell pear-shaped, nodose ; feet strongly divergent stout, about as long as thorax.....tribulus

Shell inflated, rough ; feet twice as long as thorax, curved outwards.....falciferum

Shell conical, tuberculate ; feet twice as long as thorax, striated, curved outwards.....hirundo

Shell campanulate, rough ; feet twice as long as thorax, angular, s-shaped, or curved inwards.....sigmopodium

Shell conical, smooth ; feet 4-5 times as long as thorax, s-shaped, or curved inwards.....trichopus

Shell ovate ; feet 2-3 times as long as thorax, vertical.....tripodium

Shell ovate ; feet shorter than thorax, nearly parallel.....cypselus

Shell campanulate ; feet as long as thorax, nearly parallel .....crassipes

## 139. SETHOPERA.

Cephalis pear-shaped ; thorax also, with roundish pores.....lagena

## 140. MICROMELISSA.

Shell smooth ; wings from upper part of thorax .....microptera  
 Shell rough ; wings from lower part of thorax..... ventricosa

## 141. PEROMELISSA.

Shell rough ; two joints ovate of nearly equal size.....capito

## 142. TETRAHEDRINA.

Shell three-sided, pyramidal, smooth.....pyramidalis  
 Shell pear-shaped, papillate.....quadricornis

## 143. SETHOCHYTRIS.

Shell smooth ; thorax conical ; with 3 fenestrated cones half as long  
     as thorax .....barbadensis  
 Shell smooth ; thorax pyramidal ; with 3 pyramidal fenestrated feet,  
     nearly as long as thorax .....pyramis  
 Shell rough ; thorax pear shaped ; with three fenestrated cones, about  
     as long as thorax.....triangula

## 144. SETHAMPHORA.

Shell smooth ; thorax nearly ellipsoidal, with 18 ribs.....mongolfieri  
 Shell spiny ; thorax inflated, with 20 dentate ribs .....ampulla  
 Shell smooth ; thorax inflated, with 22-24 smooth ribs .....aerostatica

## 145. SETHOPYRAMIS.

Shell with 6 radial main beams (sometimes with 5 or 7)..... scalaris  
 Shell with 9 radial main beams (sometimes with 8 or 10).....quadratella

## 146. PLECTOPYRAMIS.

Shell with 6 radial main beams (sometimes with 5 or 7)..... magnifica  
 Shell with 9 radial main beams (sometimes with 8 or 10).....fenestrata

## 147. ACANTHOCORYS.

Thorax with 6 divergent ribs.....butschlii

## 148. ANTHOCYRTOMA.

Shell pear-shaped, rough, with obliterated collar stricture.....serrulata

## 149. ANTHOCYRTIS.

Feet divergent, triangular, about as long as thorax.....mespilus  
 Feet divergent, curved, forked, about as long as shell .....furcata  
 Feet divergent, conical, about 1-5th the diam. of shell.....ventricosa  
 Feet parallel, conical, about as long as cephalis.....grossularia

## 150. ANTHOCYRTIUM.

Feet divergent, shell smooth, thorax hemispherical.....	centaurea
Feet divergent, shell rough, thorax truncate, conical.....	collare
Feet divergent, shell spiny, thorax pear-shaped.....	anemone
Feet parallel, shell rough, feet shorter than cephalis.....	reticulatum
Feet parallel, shell thorny, feet about as long as cephalis.....	leptostylum
Feet parallel, shell thorny, feet nearly as long as thorax.....	hispidum
Feet convergent, shell rough, feet nearly as long as thorax.....	ficus

## 151. ANTHOCYRTIDIUM.

Shell campanulate, rough, horn as long as the shell .....	matricaria
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## 152. CARPOCANIUM.

Peristome with 6 feet .....	setosum
Peristome with 25-30 feet.....	coronatum

## 153. SETHOCONUS.

Cephalis large, with small pores and with horn of same length.....	cucullaris
Cephalis large, with horn twice the length.....	ampliatius
Cephalis large, with large pores and with horn of same length.....	mitra
Cephalis large, with 5-10 horns.....	larvatus
Cephalis large, horn with 3 spines at base.....	nassa
Cephalis small, with horn of same length.....	gracilis
Cephalis very small, with horn half the length.....	clathratus

(To be Continued.)

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**EDITORIAL.**

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**American Microscopical Society.**—We have offered to enclose in our July issue a program of the Ithaca meeting and although at the time of this writing, it has not arrived, we expect to receive the copies before binding this number. We purpose sending the full program to all our subscribers whether members of the society or not.

Every mail is bringing in signed copies of the petition which we have prepared asking that we have the privilege of publishing the papers presented to the society with the consent of the society. The past two years we have published the papers or abstracts without the consent of the society and in face of its rule forbidding members to give out their papers for publication. Should it be necessary, we shall hereafter be able to practically nullify that absurd rule, but we hope that the unpleasant duty will not be forced upon us.

During the past five months we have been making a few exposures of the methods employed in the past to run the society and some of our correspondents have offered us more material of the same sort. None of those who have been concerned in these doings have come forward to use our columns for the purpose of explaining why they sold the presidency for prize money, or why they tried to get an undelivered address palmed off on the membership, or why they made the past three meetings such farces. Evidently wisdom is better than valor in this case and silence the only policy.

So discrete has the secretary become, that we think him a suitable candidate for election to the presidency at the coming meeting and we renew the suggestion made two years ago that he be given that honor. Had our suggestion been heeded in 1893 to transfer him from the Secretaryship which he has never had the time to properly attend to, and grant him the honor earned by the work he had already done, the disgrace and ignominious failures of the past two years might have been averted. To properly perform the duties of Secretary when they include editing and publishing "Proceedings" and preparing and carrying out the general policy of the society requires an average of four or five hours work daily throughout the year.

Professor Seaman has been engaged during these years as an examiner in the Patent Office where he is expected to earn his nice government salary. He is professor of chemistry in the Howard University where he has been called upon to earn a second salary and spend lots of time. Even if he neglects some of his duties, and we do not imagine that to be the case, he is yet put under a severe strain.

But, during the past three years he has had other ambitions. He has been curator of the local Microscopical Society to the duties of which he ought to have devoted many hours and perhaps has. He has been president of the Washington Chemical Society and had to prepare and present an address which should be a creditable affair. As president it has been his duty to preside over its general welfare, devoting time and thought to it. Being a religious man he has devoted time to church duties. Being a family man he takes care of a family. Being

a man of property, he looks after his houses and lands. Being a camera club man he spends time making pictures. Wanting something from the American Microscopical Society and its "Proceedings," he has held on the office of Secretary till he certainly must be sick of it. Who but a man that lets his ambitions run away with his reason would undertake and persist in retaining the office alluded to in face of such numerous and time-consuming duties? Who but a man half-insane from over work would persist in such a course. What society but the A. M. S., would permit it?

We have spoken plainly. With equal plainness and sincerity, we humbly and modestly ask for Professor Seaman the honor of election to the Presidency for 1895-96. He is qualified, as we have proven. He has erred and injured the society by his overweening ambitions, but we all err and some do worse than he has done. He has at various times done much work for the society. Who has done more? That the honor will gratify him is shown by his ambitious character. There is no one whom we prefer to see receive it this year.

As to dues. We know that many microscopists are feeling compelled to economize. The calls for money are legion, some of which are imperative. To pay dues is not an absolute necessity. And then one has so many dues. A friend recently said that he found himself paying dues to over 20 organizations. He sat down and wrote resignations from 15 of them. And yet he has a very fine income. Think over the list of societies to which you belong. Do you pay the dues to all of them? Can you afford it? Ought the money to go elsewhere?

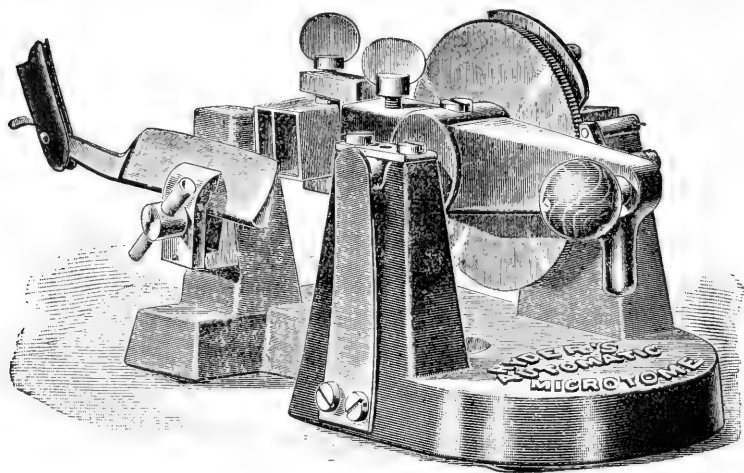
It is our solemn conviction, after hearing both sides of the question, that one of the things the A. M. S., has to do is to reduce its charges for membership. We have on our subscription lists several hundred names of people who are not members and who evidently will not pay the price. Yet any one who has taken a microscopical periodical for 10 years ought to be a desirable candidate for membership.

**Professor Leslie A. Lee** will conduct the Bowdoin College Summer Courses in chemistry, physics and biology at Brunswick, Maine, beginning July 9. Those interested will be fort-

unate to get this contact with a most agreeable teacher of biology.

### MICROSCOPICAL APPARATUS.

**Automatic Microtome.**—This new instrument has been devised by Professor John A. Ryder, of the Biological Department of the University of Pennsylvania, in order to facilitate the preparation of sections for large classes, and also for the rapid preparation of series of sections in ribbons in embryological work, in which the element of time becomes a serious consideration. The device is small and compact, and is also automatic—that is, the same movement which cuts the section a'so



One-half size.

brings the block into position for cutting the next successive section, and so on continuously, of any desired uniform thickness the cutting takes place as fast as it is possible to move a vibrating lever up and down through a distance of three inches with the right hand. Nearly all other automatic microtomes are costly, unwieldy, large and heavy, or else very complicated and liable to get out of order. The only exception in part to this rule is the Rocking Microtome, made in Cambridge, England; but it cuts in an arc, so that the sections are segments



of a hollow cylinder, and not parts of a perfect plane; besides, the rocking or vibrating arm admits of only a very limited movement, so that the instrument is suitable only for cutting sections of objects of very limited dimensions; nor is the position of the block adjustable. Moreover in none of the automatic microtomes now in use it is possible to place the knife at right angles or any other desired angle to the direction in which the block to be cut is moved—a great desideratum in botanical or other work in which an inclined knife is necessary. In order to supply an instrument serviceable especially to teachers, as well as to all classes of students, botanists, pathologists, histologists and zoologists, the designer has attempted to bring together all the desirable features of previously invented instruments in as simple, convenient and compact a form as possible, without sacrificing rapidity and efficiency of action.

The working parts are an oscillating lever, which is provided with a clamp at one end into which the paraffine-holders are adjusted, and at the other with a simple handle. This lever rests upon trunnions on either side, and these in turn rest in triangular notches at the top of the two pillars, between which the lever oscillates. At the cutting end of the lever a spring pulls the lever down and effects the sectioning and also the adjustment for the next section. The lever is pushed over and adjusted for the successive sections by a hollow screw, through which passes the trunnion on the side away from the knife. This screw is fixed to a toothed wheel, three inches in diameter, which revolves close by the side of the oscillating lever. The toothed wheel and screw, actuated by a pawl fixed to the side of the lever near the handle. The number of teeth which this pawl can pass in a single vibration, downward is controlled by a fixed stop screwed into the under side of the oscillating lever near the handle; the end of this stop striking on the top of the bed-plate thus brings the lever to rest at a constant point in its downward excursion. An adjustable sector by the side of the toothed wheel throws the pawl out of gear after a given radius of the wheel has been turned through an arc embracing the desired number of teeth. This adjustment is also effected before

the block containing the object to be cut reaches the edge of the knife. The adjustment for the next section is therefore effected while the surface of the block is not in contact with the under side of the knife, so that no flattening or scraping effect is produced on the surface of the block in its upward passage past the knife.

The movement of the vibrating lever being arrested at each down stroke at one point, and the pawl which catches into the notches in the toothed wheel being released at any desired point by the action of the adjustable sector, it is possible to adjust the apparatus with great accuracy for cutting sections of any desired thickness. If a given radius of the wheel is moved through the arc embraced by a single tooth, sections are cut having a thickness of only  $\frac{1}{10000}$  of an inch, or .0025 mm.—a thickness which is only practically possible with paraffine embedding and a very keen razor. If more teeth are taken by the pawl, any thickness of section is possible up to about  $\frac{1}{400}$  of an inch, or .0625 mm.<sup>1</sup>

A freezing attachment which has lately been appended to the apparatus shows that frozen sections can be made with as great rapidity and success as those cut from objects embedded in the paraffine block, and very nearly, if not quite, as thin. The freezing attachment is as simple and efficient as the self adjusting and cutting devices of the instrument. Other auxiliary apparatus makes it possible to cut celloidin sections. This is effected by means of alcohol conducted by a tube from a reservoir to the knife, over which the fluid will run and drain into a tray below in such a way as not to come in contact with any other parts of the machine. This tray fits into a recess in the side of the bed-plate of the instrument just below the knife, and into this tray the celloidin sections may be allowed to drop as fast as cut.

The paraffine-holders are square and seven-eighths of an inch in diameter, so that a block of that size may very readily be sectioned. For the botanist, one of these holders is provided

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<sup>1</sup> The screw which adjusts the block for cutting has exactly fifty threads to the inch, and there are two hundred teeth on the periphery of the toothed wheel. The value of a single tooth is, therefore,  $\frac{1}{50} \times \frac{1}{200} = \frac{1}{10000}$  inch.

with a movable side and screw for clamping objects, so that rather tough stems may be firmly held between blocks of cork, while the more delicate vegetable tissues, or such as must be embedded in fresh carrot, soaked in gum and hardened in alcohol, may also be firmly held for sectioning by the same device, provided the pieces of carrot are first trimmed into the right shape. The same style of holder is equally applicable for holding the corks—if properly trimmed—upon which tissues are embedded in celloidin or in gum. This style of holder also enables one to embed very long objects entire in paraffine—such as earth-worms—and to cut them as a single piece, provided the surrounding paraffine is carefully trimmed so as to have two opposite sides parallel. An object six inches long and three-quarters of an inch in diameter embedded in this way may be cut into an absolute continuous series of sections without losing any essential portions. This is accomplished by slipping the block through the quadrangular clamp for the distance of half an inch every time a half-inch of the object has been cut off in the form of sections. One-half inch is the length of block which can be cut at one time without re-adjusting the feed-screw which moves the block and vibrating lever over toward the knife, the whole being kept firmly in place against the face of the hollow screw by a strong spring which presses against the end of the trunnion on the outside of the iron pillar on that side of the instrument where the knife is fastened, so that all the sections are of exactly the same thickness from first to last. Cutting up large objects in the manner above described is not possible with any other form of microtome yet constructed.

Almost any section knife—wide or narrow-bladed—will fit into and be firmly held by the knife-clamp, which is, however, intended more especially to hold an ordinary razor. The best razors for cutting sections have been found to be those of the best make only, such as Wade & Butcher, or Joseph Rodgers & Sons, of Sheffield. Only such razors as hold an edge well should be used.

For ribbon cutting by the paraffine method, the block containing the object, after it is trimmed and soldered to the paraffine with which the holder is filled, by means of a heated wire,

is covered with a thin coat of soft paraffine or "paraffine gum," and of which "chewing gum"\* is made. This enables one to cut ribbons of any desired length, since the softer paraffine at the edges of the successive sections stick them together by their margins as fast as they are cut.

The ribbons may be allowed to fall upon a slip of paper, which may be drawn out, as fast as the sections are cut, from under the bed-plate of the instrument, beneath which there is a space left for this purpose between the three toes or tripod upon which the whole apparatus rests. The edge of the knife also remains in the same plane, no matter at what angle the cutting edge is placed with reference to the direction in which the block to be cut is moved, just as in the best forms of the sledge microtome.

Complete instrument, including knife and walnut case, \$25.

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### BACTERIOLOGY.

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**Tuberculosis.**—A Royal Commission appointed five years ago by the British Parliament has concluded extensive researches and reports:

"We have obtained ample evidence that food derived from tuberculous animals can produce tuberculosis in healthy animals. The proportion of animals contracting tuberculosis after experimental use of such food is different in one and another class of animals; both carnivora and herbivora are susceptible and the proportion in pigs is high. In the absence of direct experiments on human subjects we infer that man also can acquire tuberculosis by feeding upon materials derived from tuberculous food animals. The actual amount of tuberculous disease among certain classes of food animals is so large as to afford to man frequent occasions for contracting the disease through his food. As to the proportion of tuberculosis acquired by man through his food or through other means we can form

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\* Chewing gum may be rendered available for this purpose if it is melted at a temperature somewhat above boiling, when the sugar which it contains will separate as caramel, leaving the pure paraffine gum, which may be drained off and used as directed, if the manipulator should find it difficult to get the paraffine gum of commerce.

no definite opinion, but we think it probable that an appreciable part of the tuberculosis that affects man is obtained through his food. The circumstances and conditions with regard to the tuberculosis in the food animals which lead to the production of tuberculosis in man are, ultimately, the presence of active tuberculous matter in the food taken from the animal and consumed by the man in a raw or insufficiently cooked state. Tuberculous disease is observed most frequently in swine and in cattle. It is found far more frequently in cattle (full grown) than in calves and with much greater frequency in cows kept in town cow-houses than in cattle bred for the express purpose of slaughter. Tuberculous matter is but seldom found in the meat substance of the carcass; it is principally found in the organs, membranes, and glands. There is reason to believe that tuberculous matter, when present in meat sold to the public, is more commonly due to the contamination of the surface of the meat with material derived from other diseased parts than to disease of the meat itself. The same matter is found in the milk of cows when the udder has become invaded by tuberculous disease, and seldom or never when the udder is not diseased. Tuberculous matter in milk is exceptionally active in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of the tuberculosis which man obtains through his food is by means of milk containing tuberculous matter. The recognition of tuberculous disease during the life of an animal is not wholly unattended with difficulty. Happily, however, it can in most cases be detected with certainty in the udders of milch cows. Provided every part that is the seat of tuberculous matter be avoided and destroyed, and provided care be taken to save from contamination by such matter the actual meat substance of a tuberculous animal, a great deal of meat from animals affected by tuberculosis may be eaten without risk to the consumer. Ordinary processes of cooking applied to meat which has got contaminated on its surface are probably sufficient to destroy the harmful quality. They would not avail to render wholesome any piece of meat that contaminated tuberculous matter in its deeper parts. In regard to milk, we are aware of the preference by English people for drinking cows milk raw—a

practice attended by danger on account of possible contamination by pathogenic organisms. The boiling of milk, even for a moment, would probably be sufficient to remove the very dangerous quality of tuberculous milk. We note that your Majesty's gracious commands do not extend to inquiry or report on administrative procedures available for reducing the amount of tuberculous material in the food supplied by animals to man, and we have regarded such questions as being beyond our province.—Sir George Buchanan, Prof. G. T. Brown, Dr. G. F. Payne, Prof. Berdon Sanderson.

### **MICROSCOPICAL MANIPULATION.**

**To Photograph Vertically.**—Mr. Leslie of Barrackpore, India, mounts his microscope in a vertical position on a base board and adjusts it as for ordinary use. On each side of the instrument are uprights, between which slides a small box about six inches square and four or five deep. It works up and down in slots cut through the two uprights, to which the box can be fixed firmly above the microscope by set screws on either side. At the bottom of the box is an apparatus considerably larger than the tube, and around this aperture is a sleeve made of black cloth, or silk, which hangs down vertically from the box and is fastened round the tube. At the top of the small box grooves are cut as in a camera, to insert the ground-glass frame and the dark slide.

The mirror of the instrument is now adjusted so as to illuminate the object (on the stage). The source of illumination may be daylight or lamp light. The ground glass frame is now inserted in the box which is either raised or lowered till the proper sized disc of light is obtained in the ground glass. The object is now focused by means of the coarse and fine adjustments of the microscope which are under full control of the operator.

The microscope is now moved if necessary on the baseboard till the disc is in a proper position on the ground glass. In front of the mirror of the microscope is a blackened cardboard shutter, which is attached to one of the uprights, in order to cut off the light from the mirror. When the proper focus has been secured, this cardboard shutter is lowered and the light cut off

while the dark slide with the sensitive plate is being inserted and the slide drawn. The shutter in front of the mirror is now raised, and an exposure of 30 to 45 seconds is made if with lamp-light, or of 5 to 15 seconds if with daylight.

**Seeing Air-Borne Spores.**—At the April meeting of the Calcutta Microscopical Society, Mr. W. J. Simmons described his method of making an observation of dust with the view of detecting in it the air-borne spores which are said to cause moulds to grow in a manner which the earlier observers believed favored the doctrine of spontaneous generation. The method is simplicity itself, and consists in placing a drop of pure glycerine on the centre of a slip of glass measuring three inches by one inch. The drop is smeared over the glass lightly so as to cover a surface of about three-quarter inches in diameter, and is then exposed to the air for two or three days. When the dust which settles on the smear is to be examined under the microscope, a circular cover glass is placed on it, and the deposit is now shown by the microscope to be composed of a most heterogeneous collection of objects. Fibres of all sorts, the scales from insects, wings, root, pollen, starch, down, fragments of epidermis, and of the cuticle of plants, hair, entire mites, numberless inorganic particles, charred straw, portions of insects, hairs from plants, and several spores of fungi are thus revealed.

If a drop of glycerine, half an inch in diameter, arrests so many spores, how many do we inhale daily, and how many are deposited on our food in the course of a day? The study of dust is not one suited to a beginner in microscopy, because it presupposed familiarity with the thousand and one objects which are certain to be present on the glass slip; but it presents no insuperable difficulties, and does not demand any special or costly appliances.

### **BIOLOGICAL NOTES.**

**Sand Fly.**—These pests are found on the Florida sea coast. While mosquitoes at times may make a person forget all his other trouble, the sand fly will make him think he has added a new one. The principal feature of interest is their bill, short

and blunt; and, unlike the mosquito, they do not stop to hunt a soft spot to insert it, but just settle down to business where they happen to alight. This appendage is in shape something like a duck's bill, and quite unlike that of its co-worker; the bite is to many people more severe, the effects do not usually last as long. The "saw" is curved at the end and has its teeth along the concave edge. The wings have a very pretto mottled appearance when folded over the body of the insect in life. Their favorite time to put in an appearance is during a calm just before rain storms, especially if the atmosphere is close and "muggy." At some times of the year they arrive from the sand in swarms during the early morning hours and towards sunset as the breeze dies out; a light wind is sufficient to keep them down. A net made of cheese cloth is often used to cover the beds of those who live in localities infested by these insects, but this protection is not always effective, as the writer can testify, and it becomes necessary to close doors and windows as tight as possible and make a "smudge" of insect powder to quiet them down. Even the Seminole Indians of the Everglades have adopted the white man's nets and other means of guarding against them—*E. S. Coutant.*

## **MICROSCOPICAL SOCIETIES.**

### **Lincoln Microscope Club.**

*March 6th.* 1895. The secretary was directed to prepare a list of the works and periodicals relating to microscopy accessible to members of the club in the various departments of the university.

Dr. Ward delivered the annual president's address; subject, —The Tapeworm.

Dr. Bessey spoke further of a device for marking slides exhibited by him at the last meeting.

Mr. Dales exhibited a lamp for microscopical work; also slides of *Actinomyces*.

*March 28th.,* 1895. A business meeting only. The secretary was directed to subscribe for the following periodicals not taken by the university: *Zeitschrift fur wissenschaftliche mikroskopie*; *Journal of the Queckett Club*; *International Journal of Microscopy and Natural Science*; *The Microscope*.







EPHRAIM CUTTER, M.D., LL.D., Hon. F.S.Sc. (Lond.).

Use of Clinical Microscope, 1-10 inch objective, with direct light of candle.

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Some Details as to Tolles' 1-75th Objective.

BY EPHRAIM CUTTER, M. D., LL. D.\*  
NEW YORK.

EXPLANATORY.—So far as these items, which are furnished by request for this JOURNAL, touch others, it is pleasant to give them. Egoisms have small place in science, to be given only when they cannot be avoided. This paper is to be taken as a compliance with requests from such a source that not to heed them would show ill grace. The one-seventy-fifth microscope objective was made for a certain work. It did that work. Indeed it did more. It put American artizanship as worthy of a place among foreign artizans, the latter being voluntarily witnesses.

DETAILS.

1. The one-seventy-fifth was ordered for this purpose: In 1869, Geo. B. Harriman, D. D. S., of Boston, discovered a simple novel mode of dissecting teeth, which was to turn them on a lathe as iron is turned. Thus he succeeded in demonstrating the nerve axis cylinder of dentine. Though toothache means nerves in dentine, Dr. Harriman's statement was denied. To confirm his discovery Dr. H. ordered Robert B. Tolles, in 1870, to make this objective—giving him carte blanche

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\*Professor of Clinical Morphology and Applied Medicine, College of Physicians and Surgeons, Boston, Mass., Princ. School of Micrology, N. Y.

as to price and time. Mr. Tolles, loath to undertake the order, was overpersuaded, and in three years, June 2d, 1873, handed it over to Dr. Harriman. Mr. Tolles told the writer that he would never make another because of the difficulties, and that only persistent pushing and urging brought forth the one-seventy-fifth. Dr. Harriman avers that the one-seventy-fifth did demonstrate and confirm the presence of axis nerve cylinders in dentine and thus realized its aim. So far as the writer knows, it sustains the claim of Dr. Harriman as the discoverer of nerve fibers in dentine in 1869.

2. Boston, October 2, 1894. *To whom it may concern :* This certifies that I, George B. Harriman of my own accord ordered the late Robert B. Tolles to make me a one-seventy-fifth inch objective in the year 1870 ; that I paid \$400 therefor, and I have his receipt ; that I ordered it because I wished to verify my discovery of the axis nerve cylinder of the nerves of dentine by using a new mode of sections of dentine as iron is turned in a lathe ; that the one-seventy-fifth inch objective did verify the presence of dentinal nerve tissue fiber ; and that this objective did all I expected it to do and more.

*Signed,* GEORGE B. HARRIMAN.

Dr. A. C. Stokes has characterized this objective in his late book thus : " Nothing more miserable can be conceived." This being so, then the realization of one's expectations has been generally misunderstood and the English language must be rewritten to suit this new definition of our friend, who wrote as he felt, honestly no doubt, but who will find it hard to change the dictionaries to meet his new definition.

3. Mr. John Green, of East Boston, Mr. Tolles' first assistant, has allowed the use of the following, Tolles' autographic memorandum of the one-seventy-fifth as follows :

		Tk.	Mid.	.0235	Tk.
Bk.	.0260	.008	(.028)	.0235	.0085
	.0215		Ap.	.0235	
.028	.0215			.280 ex	H. F.
Ap.	.43 ex	.002			
		H. H. D.			
Front		Tk.		Delivered July 2, 1873	
		.0065			
		H. F.		Angular Aperture, 178°	

4. R. B. Tolles' memorandum, July 2, 1873: "Examined *Navicula angulatum* with sun-light and 2-inch ocular, a perfect picture, clear of all obstructions. Nothing intercepted the view." Observers: "Self and John Green. Afterwards exhibited same to Dr. Harriman and Mr. Wells. Sun clouded over, but a very fine show."

5. What the one-seventy-fifth did for the writer. The acquaintance of Dr. Harriman having been made, he kindly allowed the free use of himself and his one-seventy-fifth inch objective, and it was resolved to try to photograph the appearances of human blood in tuberculosis for the first time in the world. A large practice was relinquished and a residence taken up in Cambridge, Mass., on the ground that a college city must contain the most appreciative and sympathizing medical talent of the highest order, that would rejoice in the solution of this knotty problem and thus aid the desired end. It is pleasant to say that these expectations were realized in such men as Prof. A. P. Clarke, dean of the College of Physicians and Surgeons of Boston, and the Vice-President of the American Medical Association, 1895, Dr. H. O. Marcy, LL. D., President American Medical Association, 1892, Surgeon-General of Massachusetts A. F. Holt, now dead, and others, whose services are hereby gratefully acknowledged.

Photographs of consumptive blood were taken in 1876, with the one-seventy-fifth that verified this morphology.

Copies of these photographs were exhibited at the

centennial exhibition, 1876, deposited in the Yale College Library, exhibited in London, Berlin, Paris, Brussels, Glasgow, Newcastle-on-Tyne, &c., and pronounced to be inferior to none ever taken.

A somewhat technical account of the one-seventy-fifth, especially as to photography, was published in the August, 1879, number of the American Journal of Arts and Sciences, Journal de Micrographie, Paris, 1879, and Scientific American, 1879.

6. The one-seventy-fifth inch objective verified the morphology of Syphilitic Blood.

7. It verified the morphology of epidemic influenza.

8. It beautifully photographed alcoholic yeast. (*Cerevisia saccharomyces*).

9. It elicited the following from Dr. O. W. Holmes, when, by his invitation, Dr. Harriman and myself had made him a lantern demonstration. Just as we were leaving he said: "Gentlemen, never has any one come to my house who has taught me so much as you have."

10. At London, 1889, Sir M. Mackenzie asked me to let him see the one-seventy-fifth. It was shown and thereby its owner was introduced at a banquet given, as he said, "to persons of the very highest influence in London,"—in language that can only be uttered to the most intimate friends or college classmates. These guests were Col. North, the Nitrate King, Sir Spencer Wells, Sir Augustus Harris, Sir W. A. Mackinnon, Sir A. Isaacs (Lord Mayor, 1889-90), Mr. McKenna (the young millionaire), Edmund Yates, Surgeon-Major Johnston (Aldershot) and A. N. Broadley.

11. It introduced its owner to the War Office at the invitation of Sir W. A. MacKinnon, the highest medical official of the British army, to show its work to his staff. Afterward, it was said: "Never has anyone here shown us such good work with the microscope."

12. At the earnest invitation of Sir W. A. MacKinnon, it was exhibited in a lecture on clinical morphology at Aldershot, the headquarters of the British army, to a most respectful audience of from forty to fifty army surgeons. This was followed by a vote of thanks and a banquet which was tendered to the owner.

13. It secured permission for the owner to do clinical morphological work in any army hospital in Great Britain.

14. A special lantern exhibition was given in London, 1889, to Sir W. A. MacKinnon, Sir A. Isaacs, Dr. Johnston and others at the residence of one of the editors of the "World." The first photograph taken with it elicited from Sir MacKenzie the words: "Wonderful, wonderful!" The Lord Mayor-elect was told that it was a great honor to have him present. "Oh, no," said he, "if is an honor to come; this one-seventy-fifth is the talk of London."

15. It caused Dr. MacKenzie to utter these parting words: "Your visit to London has been a great success." Which utterance is now a precious legacy made sacred by his death.

16. As to the photographs taken by Dr. Harriman and myself, they were pronounced in Paris not inferior to any ever taken.

17. January 29, 1891, Dr. Kohler, of Vienna, wrote for some of them to exhibit to the Royal Imperial Medical Society, of Vienna, "in order," as he said, "to be up with the times."

18. In Brussels, they received high commendation.

19. At the Berlin International Medical Congress, better ones were sought among the medical exhibits, but none better were found.

20. A gentleman representing a firm composed of the best microscope makers in Germany, having seen these

photographs, expressed a desire to look through the objective. Having done so, with a most impressive gesture, he said: "I thank you very much for this; it is the event of my life. I never expected to live to see such an instrument and such workmanship. We do not make them because people will not pay for them." Tolles' B stand, American oil light, direct, and a two-inch ocular were used on this occasion.

21. A London maker, of the very highest reputation and character, having witnessed a similar exhibition, expressed less demonstratively his satisfaction, but said that Mr. Tolles was the peer of any maker. He added "I made a one-eightieth inch objective, but it was not good." He would not tell who owned it. It has been verbally reported that photographs have since been taken with it.

22. This objective shows the value of direct light, especially from a clay wick, which gives 25 per cent more illumination than cotton gives. Used two hundred years ago by microscopists, "direct" light had gone into disuse until about forty-five years ago; Oliver Wendell Holmes taught its use to his pupils. He said that W. A. Spencer had also used it in testing objectives in course of construction. I have seen Mr. Tolles often do the same thing in his workshops. Even he did not get the best results with the one-seventy-fifth save by sun-light until the writer used the flat edge of an oil flame condensed "direct" by a one-inch ocular fitted into the sub-stage. This illumination has been entirely satisfactory and reliable. As compared with mirror light, it may be said to be *thrice* as effective.

23. The opening for light in the one-seventy-fifth is one-sixty-fourth inch. The amount of illumination shown in the first photograph justifies the above quoted remarks of Sir M. MacKenzie and the approval of all



others whose attention has been called to it. Certainly, direct light is ample for all lower powers. Probably too large openings for light are allowed with most objectives. Certainly, if direct light is used, such is the case. Mr. Tolles made for me a clinical microscope with one-inch ocular and with one-fourth inch objective, second-class and with ten-inch tube. The working distance was five thirty-seconds of an inch, the stage to remain save when objectives are changed. I asked him to reduce the stage opening to its smallest size. It has worked well for more than twenty years. Not long ago, Mr. Albert Storer, a Boston expert, found it to be one-twenty-fifth inch in diameter. Mr. Tolles also made for me another and much more expensive clinical microscope, with "huge" inside lenses, but he had to diaphragm the inside of this objective because the light was dazzling. The light of a common stearine candle, costing one cent, used direct with a two-inch eyepiece for condenser has given a good field and brought out details with Tolles' one-fiftieth inch objective. The same with reflected light gives a field containing only one-fourth of the direct illumination.

24. Projection work of this objective has been done on a large scale. In 1879, at Boston, in lectures at which were present two thousand educated people, a screen twenty-five feet square was successfully covered with lime-light projections of the one-seventy-fifth photographs. In evidence of this, a gentleman from London stated that he had seen the best work of the Polytechnic Institute, that he felt qualified to judge, and that this work of the one-seventy-fifth was unapproachable.

25. As, at that time, considerable antagonism was shown toward the one-seventy-fifth, a learned and famous individual connected with the above-named lectures visited all Europe and took pains to ascertain the

facts, but found nothing to contradict the statement last cited. At that time, also, physicians were asserting, over their own names in the daily press, that there was no one-seventy-fifth in existence, but, confronted with it, they then said it was good for nothing. The satisfaction expressed by thousands who have seen the public demonstrations, ought to suffice.

26. This is a letter dated editorial rooms "Our Day," 17 Beacon Street, Boston, January 30, 1895: "Dear Dr. Cutter: That powerful microscope of which you asked me to give an opinion needs no commendation except its own worth. It was greatly admired in the exhibitions you gave in Boston to my audiences of from 2000 to 3000 people, and containing hundreds of teachers, preachers and other educated men. The instrument has a history in Boston and New York that establishes its fame. Yours truly, JOSEPH COOK."

27. In relation "to the use of the one-seventy-fifth in microchemical examinations of blood-stains," Dr. Harri-man writes, January 25, 1895: "\* \* \* \* \* When compared with lower power objectives, the one-seventy-fifth made by Tolles presents a very striking exhibition of blood corpuscles, clear, round and well defined, and there is no mistaking the difference under such high magnifying power. The morphological changes are more ably demonstrated by its use. \* \* \* \*"

28. Recently, it has brought out the so-called "Plasmodium malariae" in red blood corpuscles with surprising beauty, clearness and color. I say "so-called," because the patient did not have malaria, and I say this because the appearances varied from the typical plasmodium to twin symmetrical spores, and because the color of these spores was distinctly copper-colored. For years I have taught that this was characteristic of the spores of *Crypta syphilitica*.

29. This objective can be used dry or wet, with a cover one two-hundred-and-fiftieth inch thick, or without a cover.

*Partial List of Papers involving the One-seventy-fifth.*

BY G. B. HARRIMAN, D. D. S.

"Discovery of Nerve Fibers in the Soft Solids of Dentine." Dental Cosmos, January, 1870.

"The Microscope." Dental Register, March, 1874.

"The Use of the One-Seventy-Fifth Objective in Microchemical Examinations of Blood-Stains." (Unpublished.)

BY E. CUTTER.

Lecture before the Chicago Medical Society, February 17, 1879, on "The Morphology of Diseased Blood." Chicago Medical Journal, 1879.

"Tolles' One-Seventy-Fifth Objective, its History, Uses and Construction." American Journal of Arts and Sciences, New Haven, August, 1879.

"Leavens and Man." Written by invitation of the Philosophical Society of Great Britain, 1882. (Bread bacteria are figured among the fifty or more illustrations).

"A New Physical Sign of the Pre-Tubercular State." 1877, sixty-eight illustrations.

Illustrated lecture on "Alcohol and Blood." Tribune (Cambridge, January 15, 1879.

## Microscopical Technique Applied to Histology.—X.

[FROM THE FRENCH OF RENE BONEVAL.]

(Continued from page 197, July, 1895.)

*Intestinal coats; villi.*—For the different layers no special technique is needed. Sections made of the opened intestine, after hardening by gum and alcohol, stained in picro-carmin, supply the preparations. The muscular elements of the villi are well seen in all these sections, especially when, after fixing by bichromate, they are stained in hæmatoxylin and eosine. Mount in balsam.

*Blood vessels.*—To study these, inject them by the method already described. Decapitate a rat, open the thorax and introduce the syringe into the thoracic aorta.

When the material returns through the vena cava, close the latter and fill the vessels. About fifteen cc. will be needed for a small rat. When cold, open the abdomen and place it in 2 per cent bichromate. With the scissors remove pieces bearing villi and examine flat in glycerine. Make sections perpendicular to the surface after hardening in gum and alcohol. Stain in hæmatoxylin, mount in balsam.

*Lymphatics.*—To inject the lymphatics of the rabbit, begin by injecting the blood vessels with the red or carmine mass. Thrust a short hypodermic needle into the mesentery near its attachment to the intestine and force in the Prussian blue mass. Spread out the intestine in a saucer of alcohol; cut sections perpendicular to the surface; mount in balsam.

*Physiological injection of the lymphatics.*—Starve a rat for twenty-four hours, then feed it on fat. Cut out, with scissors, some villi, and expose to osmic acid fumes. Mount in glycerine. The fat, which fills the lymphatics, is blackened and admirably marks out the form and position of the vessels.

*Endothelium of the lymphatics.*—Proceed as for the injection of the lymphatic vessels of the rabbit, using the following silver nitrate injecting mass: Gelatine, 2; one per cent solution silver nitrate, 1. Soak the gelatine in distilled water, melt it on a water bath and add the silver solution.

(1) Cut sections perpendicular to the surface of the intestine after hardening by gum and alcohol.

(2) Put a portion in the  $\frac{1}{2}$  alcohol for 24 hours, brush away the epithelium, remove the muscular layer and examine the mucous membrane mounted flat in balsam.

*Nerves of the small intestine.*—We select a loop of the rabbit's small intestine in which to study the plexus of Meissner and that of Auerbach. Ligate the intestine

at one end and fill with filtered fresh lemon juice. Ligate at the other end and place the distended intestine in a few cc. of lemon juice. In five minutes cut the intestine and wash rapidly in water. Put it in the 1 per cent gold chloride for 20 minutes, wash rapidly and reduce the gold in the  $\frac{1}{4}$  formic acid. Make the following preparations :—

(1) Detach with the forceps the longitudinal muscular layer, which will remove with it the serous coat and the plexus of Auerbach. Mount flat in glycerine.

(2) Macerate for 24 hours in the  $\frac{1}{3}$  alcohol a piece impregnated by gold; with a scalpel scrape away the villi and the glandular layer; in the same way remove the muscular coat. There remains a transparent membrane speckled with violet. It is the sub-mucous layer with the plexus of Meissner. Mount flat in glycerine.

(3) Make sections perpendicular to the surface of a piece impregnated by the gold. Harden in gum and alcohol. These preparations should show the relations of the nerve fibres to one another.

#### THE TEETH.

*Section of a fresh tooth.*—This is a wearisome operation which may be avoided by buying the beautiful preparations of the dealers. The writer has had no experience in preparing fresh teeth.

*Section of a decalcified tooth.*—Suspend a tooth by a thread in Kleinenberg's liquid (saturated solution of picric acid, 100; nitric acid, 2). When the tissue is perfectly flexible so that it may be cut with a scalpel, wash in water until all the acid is removed. Harden in gum and alcohol, section, stain in picro-carmin.

#### SALIVARY GLANDS.

It is in the guinea-pig or the dog that we may study the serous type (parotid) and the mucous type (sub-maxillary) of mucous glands.

*Dissociation.*—Take a piece of gland one or two mm. thick, and put it for 24 hours in a few cc. of the  $\frac{1}{3}$  alcohol. It is then only necessary to agitate the piece in a drop of the  $\frac{1}{3}$  alcohol to obtain magnificent cells perfectly isolated. Stain in picro-carmin. Cover after partly drying, as already described.

*Sections.*—(1) A piece of gland is fixed for 24 hours in strong alcohol, hardened in gum and alcohol, sectioned, stained in picro-carmin, mounted in glycerine. This method gives splendid preparations of mucous glands.

(2) A piece of gland is put in osmic acid for 12 hours, washed, hardened in gum and alcohol. Examine the sections in water, or stain well in alum carmin, and mount in glycerine.

(3) Place a piece in ammonia bichromate (2 per cent) for eight days, wash, harden in gum and alcohol; stain sections in hæmatoxylin and eosine; mount in balsam.

(4) Fix in bichromate, inject the blood vessels by the Prussian blue mass, stain in hæmatoxylin, mount in balsam. (This is the first time the author has recommended the use of balsam, always preferring dammar.)

#### THE LIVER.

Take the liver of an animal dead for some hours. Cut out a piece and scrape it with a scalpel. Place the result on a slide with a drop of picro-carmin; you will see a crowd of isolated cells like little polyhedral blocks, with blunt borders. These are the elements modified by cadaveric changes. To see the cells fixed in the living state, macerate in the  $\frac{1}{3}$  alcohol a small piece taken from a recently killed animal and scrape it as described. Another method, more difficult but infinitely better, is to place a small cube of liver (1 mm. square) in 1 per cent osmic acid, and in 24 hours dissociate on a slide in a drop of water.

*Sections.*—Select the pig's liver, because the lobules are clearly circumscribed by connective tissue, especially at the surface, from which take the pieces to be sectioned. To prevent pressure of the part to be cut, remove a cube by a very sharp razor with no pressure of the fingers and use it for sectioning.

*Fixing.*—We do not recommend alcohol, but, if used, proceed thus: A cube of one half centimetre is put in absolute alcohol for twenty-four hours. Wash in water for half an hour, transfer to gum (twenty-four hours), to 95° alcohol (twenty-four to forty-eight hours). Section, stain in picro-carmin, mount in glycerine. But osmic acid is the fixative *par excellence* for the liver. Take a strip 1 mm. long, put it in 3 or 4 cc. of 1 per cent osmic acid for twenty-four hours. Wash in water for twelve hours, harden in gum and alcohol. Section, free from gum, stain in alum carmin and mount in glycerine. Picric acid may be used for these sections to show the glycogenic material. A piece 1 mm. on a side is placed, still warm, in 50 grammes of the aqueous solution of picric acid for twenty-four hours. Harden in alcohol and put the sections in water till the yellow color is gone. Stain. Ammonia bichromate (2 per cent) is very useful for fixing small pieces one half to one centimetre thick. Use a large amount of the solution (150 to 200 cc.), and renew it once or twice. After a week's sojourn in the bichromate, wash in water for twenty-four hours, harden in alcohol and gum. The sections, freed from gum, should be stained in hæmatoxylin and eosine and mounted in balsam.

*Capillary Injection.*—The vascular network may be studied in the liver of the rat. After injection, treat a small piece by bichromate for eight days, then by gum and alcohol, make sections transversely and perpendicu-

larly to the surface of the organ; mount in balsam after staining the nuclei by hæmatoxylin.

*Gall Bladder.*—To see the epithelium, open a rabbit's gall bladder and put it in an iodised serum for 24 hours; scrape the internal surface and spread the result in a drop of picro-carmin, and run glycerine under the cover after staining.

The muscular fibres should be prepared as described for the bladder of the frog.

*The nerve plexus.*—Remove the bile and inject fresh filtered lemon juice. Put the bladder in a few cc. of lemon juice and leave it for five or six minutes. Wash again and reduce the gold in the  $\frac{1}{4}$  formic acid. Examine pieces of the bladder in glycerine after brushing away the epithelium.

#### PANCREAS.

Study by the method described for the salivary glands.

To dissociate the cells, macerate fragments in  $\frac{1}{3}$  alcohol. Section after fixation by alcohol, osmic acid or ammonia bichromate.

Complete the study by using Gibbes' method, which gives beautiful differentiation of the cells. Sections made after the use of ammonia bichromate are stained for ten minutes in the following solution: distilled water, 100 grms.; vesuvine, 5. Wash rapidly in water and stain by: distilled water, 100 grms.; indigo-carmin, 5 grms. When colored a deep blue, wash in water and mount in balsam.

#### RESPIRATORY APPARATUS.

*Nasal mucous membrane.*—Take a portion from the upper region (olfactory region) and another from the lower part.

*To dissociate the epithelial cells.*—Put a piece of the



mucous membrane measuring about 1 c. in the  $\frac{1}{3}$  alcohol. In twenty-four hours scrape the surface and spread the result in a drop of the  $\frac{1}{3}$  alcohol; stain with picro-carmin and cover after partly drying. After examining the cells in the staining fluid, let glycerine run under the cover so as to penetrate the cells very slowly.

*Sections.*—After fixing by osmic acid (1 per cent) 1 mm. square of the mucous membrane, in 24 hours wash carefully (12 hours), harden in gum and alcohol, section, stain in alum carmine, mount in glycerine.

#### THE LARYNX.

This presents a frame-work, ligaments, muscles and a mucous membrane. The study of the frame-work needs no other technique than that described for cartilaginous tissue. The same may be said of the muscles and the ligaments. The mucous membrane will therefore exclusively occupy us.

Take the membrane from the pharynx of an animal just killed; do not allow it to dry. If the larynx of a man can be obtained in half an hour or even one hour after death, do not allow the opportunity to escape, as the mucous membrane is a most remarkable object for study.

*Dissociation* of the epithelial cells may be accomplished after maceration in the  $\frac{1}{3}$  alcohol, following the technique described for the olfactory epithelium.

*Sections.*—Make them perpendicular to the surface. For a fixative use alcohol, osmic acid or ammonia bichromate. Harden in gum and alcohol, stain in alum carmine if osmic acid is used, picro-carmin after alcohol and hæmatoxylin after bichromate.

For the study of the trachea and the bronchia use the preceding methods.

(To be continued).

## On a New Method of Studying Cell Motion.

BY CHAS. LESTER LEONARD, M. D.,

PHILADELPHIA, PA.

[From Proceedings of the Academy of Natural Sciences.]

Since the enunciation by Virchow, in 1858, of his theory of cellular pathology, the attention of the scientific world has been centered about the study of this unit. Nearly all the unsolved problems of medical science involve, in one way or another, the consideration of some one of the functions of the cell.

It is my purpose in this paper to call attention to a new method of studying one of these functions. I have chosen as illustrations, some of the well-known facts of physiology already seen and described by competent observers, and have confined the greater part of my study to cell motion as exemplified in the movements of the red and white blood corpuscles.

The possibility of these studies was suggested by the successful result of an experiment in instantaneous photomicrography.

The method to be illustrated consists in the making of a consecutive series of instantaneous photomicrographs of the same microscopic field taken at definite intervals, and the comparative study of the series. The results obtained by this method are the elimination to a greater extent of the personal equation of the observer, the procuring of incontestable proof of phenomena observed, the extension of the observations over any length of time, and the possibility of studying the changes occurring over the entire field at any one moment. The method also enables the student to study the condition of a fresh, living, unstained specimen for any length of time, in fields taken at definite intervals.

The original magnifications were one and two-thous-

and diameters measured by the projection of a stage micrometer upon the screen; the lantern multiplies these diameters by forty, giving on the screen 40,000 and 80,000 diameters. The time of exposure was instantaneous, at least relatively with regard to the motion of the bodies, varying in different pictures from two, to one-fourth of a second.

The results obtained as regards the photomicrography of unstained specimens is illustrated by six photomicrographs of human blood in the different forms which it assumes upon the warm stages.

The method of study is illustrated by the following series:—

*Series A.*—The amœboid motion of the white blood corpuscle. The change of shape and motion with relation to the surrounding stationary and identical fields is well marked.

*Series B.*—This series shows the power of the white blood corpuscle in forcing its way through a mass of red crenated and adherent blood corpuscles.

*Series C.*—Is of marked interest; a white corpuscle has seized upon a red corpuscle and a series of photomicrographs shows that it has dragged it through a considerable distance in a field which is proved to be stationary and identical in all the photomicrographs.

*Series D.*—This series shows motion in a red blood corpuscle, situated in a field in which the series proves no other motion took place during one-half hour. This motion must, therefore, have been produced by some inherent power in the red blood corpuscle, and as the photomicrographs show that no twist has occurred, the motion cannot be due to a previous torsion, and may therefore be considered a truly amœboid motion of the red blood corpuscle.

*Series E and F.*—Show the diapedesis of the red blood

corpuscle from a capillary in which the blood is in motion and from one in which there is the stasis of the blood. This phenomenon, therefore, occurs under two opposite conditions as regards intra-vascular blood pressure, indicating, perhaps, that diapedesis is not a filtration due to pressure, but is due to the amœboid motion and power of the red blood corpuscle.

*Series G.*—This series shows an empty capillary. Along the inner surface of its wall may be seen white corpuscles, in which the series indicates movement. The diapedesis of two red blood corpuscles from this empty capillary tends to strengthen the belief in the amœboid motion of the red blood corpuscle.

Further photomicrographs illustrate the position of the corpuscles within the capillaries, and show the presence of nuclei in the red corpuscles of the frog while in the living tissues. Different forms of the malarial plasmodia, and the application of the method to pathological studies are illustrated by other photomicrographs.

The pictures are not shown as the perfect result of this method, or as the outcome of research by it. They are simply to illustrate the author's method of studying cell motion. Inferences based on the pictures are foreign to the purpose of the communication, which is intended merely to demonstrate a method of study worthy of scientific consideration. Its usefulness in producing accurate illustrations, both for publication and for lantern slides, cannot be over-estimated, as it supplies pictures whose counterpart can be found under the microscope.

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### EDITORIAL.

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**Proceedings of the A. M. S., 1894-5, Part II.**—This number is labeled: "Entered at the postoffice, Washington, D. C., as second-class matter," but inside is the remark: "Blanks for the recommendation of new members and for the titles of papers are enclosed herewith." To enclose loose slips in such a manner is a clear infraction of the United States Postal Regulation. Is the society so hard up for money that its Secretary must try to "do" the government out of fourth-rate postage on its circulars and blanks? It is probable, however, that the vigilant postal authorities will detect the trick and require the Secretary to unwrap all his numbers and take out these slips before he can get his pamphlets mailed.

The place of printing has been changed from Washington to Ithaca, N. Y., and the printing, though passable, is not quite equal to that formerly done in Washington.

Arrangements have been made with the railroads by which those attending the Ithaca meeting, August 21, 22, 23, may get reduced rates on the certificate plan. Applications for other information should go to Prof. W. H. Seaman, 1424 11th Street, Washington, D. C.

**Legal Microscopy.**—It is of interest to know that in the late third trial of Sage versus Laidlaw, where \$40,000 were given the plaintiff, that the microscope turned the scale. It is said that Messrs. Sage and Laidlaw are the only living witnesses present at the explosion of the bomb. The others are dead. Mr. Sage wore cotton pants and Laidlaw woolen. The question was raised that, if the plaintiff's testimony was correct, wool would be found imbedded in the cotton garment of the defendant. The microscope showed not only wool fiber but also blood imbedded in the cotton fiber of the defendant's pants where it covered the left groin, thus confirming the testimony of Laidlaw and hence the verdict. Had the microscope been employed in the first trial the other two trials would have been needless. There are good reasons why lawyers should be microscopists. This case is one. Why should there not be in Law School chairs of Legal Morphology?

**A New Periodical.**—We have received the initial number (Vol. I., Part 1) for April, 1895, of the “*Zeitschrift für Angewandte Mikroskopie*,” edited by G. Marpmann and published by Robert Thost, Germany. Mr. Thost has asked us to assume the American agency.

This issue is of octavo size, 36 pages, and presents a creditable appearance. Some of the articles are :

Scenedesmus Opoliensis P. Richt. nov. sp. Von Paul Richter.

Unsere modernen Einschlussmittel, Von. G. Marpmann. Verfahren zur Fixirung von Sporen, Pollen, etc., für Glycerin und Wasserigen Einschluss. Von Hugo Reichelt.

Nachweis von gefärbter Wurst auf mikroskopischen Wege.

The price is a little high, 10 marks (\$2.50), but we shall be able to club it at a less rate probably. We shall also be able to supply sample copies.

**Personal Explanation.**—The editor of this journal has felt called upon to expose the utter collapse of the meeting of the American Microscopical Society in Brooklyn last August, and to point out some of the causes. It has been done without malice to those whose folly brought it about. We have also drawn from our subscribers very generally the opinion that the papers read at that society ought to be available for immediate publication in this periodical. The suggestion made by us (to be found on another page) has also commended itself to the good sense of most of our readers.

With such vantage ground it may be supposed that we shall go to Ithaca to try to gather the fruit. We shall do nothing of the sort. We have no axes to grind. We ask no favors. We do not even care, so far as we personally are concerned, what the society may do. That we feel interested in its prosperity is as true as that we ask no reward for our efforts. If our suggestions are adopted, the credit belongs to those who adopt them (not to us) ; if they fail, why should we feel disappointed, since it will not be our fault ? We believe that the membership has been aroused to action. We shall leave it absolutely free to do what it deems wise. But we make this explanation in

order that no one may suppose that we shall be on hand to try to have our suggestions carried out. At this writing, we do not even expect to go to Ithaca. Duty now seems to call us in a very different direction. Therefore let no one who wants to see our suggestions protected fail to exert himself accordingly. Additionally, as we stand ready to enter into arrangements to help carry on the Society's work, it would not seem quite modest for us to go and urge them. We should be accused at once by the one or ones whose pet schemes were being defeated, of log-rolling for our JOURNAL. We prefer to leave the coast clear.

We therefore say to our subscribers, both those who belong to the society and those who do not,—Whatever is done to help the cause, and, incidentally, the JOURNAL, will redound to your pleasure, and to ours because it redounds to yours. To you will be due the credit for anything you can do for the cause. In any event, we will do the best we can in the circumstances created for us. Very few of us can create our own circumstances by the intensest effort. All can make the best of what comes to them.

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### MICROSCOPICAL APPARATUS.

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**Home-made Graduated Percolating Bottle.**—At the last meeting of the Oregon Pharmaceutical Association J. Preuss told how pharmacists can construct engraved measuring bottles themselves. Select an even bottomed, ground stoppered acid bottle; smear the sides evenly an inch in width with a mixture of white wax and a small quantity of turpentine previously melted together; balance the bottle on the scales. Now take distilled water at 60°F. and begin graduating by using 100 cc. from a 100 cc. flask as the unit, at the same time checking the liquid measure by the 100 g. weight on the scale. By observing this, no discrepancy can creep in. After the liquid has come to rest, mark with a scissors point the line of the lower meniscus at both edges of the wax. Continue adding 100 cc. quantites, checking with the weights and marking, until the desired height is reached. Empty the bottle, draw the lines across the wax from the points and mark the figures into the wax by using the scis-

sors point again. Awkward as it appears, I succeeded best with the scissors. Brush the wax off clean and by means of a camel's hair pencil brush the etching fluid into the sunken numbers. After ten minutes the numbers will be marked into the glass; but better let stand over night, as a faint line will then be marked quite distinct. Scrape and wash off the wax and you will have a \$1 percolating jar.—*Western Druggist*.

**A Large Microscope, constructed especially for Bacteriological Studies.**—This instrument was invented by Dr. Roux and is manufactured by M. Stiasnie, successor to Verick, 43 Rue des Ecoles, Paris, France. It is constructed as solidly as possible, and furnished with all the useful accessories. The arrangement of the foot gives lightness and elegance to the instrument and at the same time assures great steadiness in all positions. The tube can be inclined, by means of a catch, to the horizontal position. It is provided with a fine adjustment, on a prism and a micrometer screw, and with a disc graduated into fifty parts, by means of which sections one one-hundredth of a millimeter in thickness can be measured, and this turns before a movable index.

The stage is circular, about six inches in diameter, and is of unpolished ebony. It can be exactly centred by means of two milled screws, placed on either side at the back of the stage. The movement of these screws is sufficient to admit of bringing the object into the field of the microscope when the highest powers are used, and thus forms a kind of movable stage. This stage is of sufficient size to admit of examining conveniently isolated colonies in the Petri dishes and upon large-sized slides.

The sub stage and the mirror are moved vertically and simultaneously by a track and pinion. The sub-stage is mounted upon an eccentric and is thrown out toward the right from the axis. It is made for using either the Abbe illuminator or the ordinary diaphragm. Furnished with a spring which is attached to a steel rod fastened to the under side of the stage at the left, it can be turned back on its axis and retain its exact centre during the movement.

The iris diaphragm, of 32 millimetres, is mounted upon an eccentric fastened to the sub-stage, and also is centered by a



spring which attaches it to a little rod of steel fastened to the left of the sub-stage. It is turned at will to the right. The mirror has, besides, an independent vertical and lateral movement, a forward and backward movement for oblique illumination.—Translated from *Le Micrographe Préparateur*.

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### MICROSCOPICAL MANIPULATION.

**Cell Culture of Fungi.**—In Bessy's Botany the following directions are giving for cultivating fungi, the blue mold of bread for instance, in cells: Glass, tin or india-rubber rings four to five millimeters high are fastened to ordinary glass slides: a very little water is placed in the bottom of cell so formed, to keep the air in it always moist; a small drop of the nutrient liquid, free from spores of any kind, is placed in the middle of a cover glass of the proper dimension, and in this a single spore of some particular mould is placed; the cover glass is now inverted over the cell. The preparation must be placed in a warm and saturated atmosphere. An ordinary bell-jar set over a plate of water, or, better still, of wet sand, will furnish a very good moist chamber.

**Beauties in Sponges.**—Among the most beautiful microscopic slides we have seen, says the National Druggist, is a slide of foraminifera which, under an amplifying power of 50 to 100 diameters, presents a truly enchanting spectacle. After examining them for a few moments the first and most natural question is, "Where in the world did you find them?" The questioner expects to be told that they are scarce and difficult to obtain, and is immensely astonished when informed that they come from among the sand and dust of a sponge-basket. And yet such is the fact, and they may be found in almost every new sponge. Beat out the first new sponge that you come across, and then put the sand under the microscope, and you will be amply repaid for your trouble.

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### BACTERIOLOGY.

**Utility of Microbes.**—Many persons have an idea that bacteria, or "germs" as they often are called, have no good in them,

but are all enemies of mankind. The idea, of course, arises from the fact that so many diseases are traced to the dread bacillus. Science, however, is showing that only some are malignant, while others are harmless to mankind, and some are beneficent. Indeed, it is not improbable that all of them, when we understand their true functions, may prove to be beneficent in their right place. We are even beginning to utilize them, as we utilize animals, plants and chemical bodies. The latest idea is to "set a thief to catch a thief"—that is to say, set bacteria to kill bacteria. Scott Moncrieff has patented a method of purifying sewage by bacteria in the shape of a "cultivation filter bed." It is based on the principle that bacteria exist in sewage, which are capable of, as it were, digesting and disintegrating it. They are natural scavengers, like the vultures and and carnivorous birds of the tropics, and we have only to press them into our service intelligently and they will work for us. Under favorable conditions they can, moreover, be multiplied to an indefinite extent. Mr. Moncrieff proposes to purify sewage by putrefaction, and when he starts a new filter bed he inoculates it with the contents of an old one.—*W. Druggist.*

**Bacteriological Work in Chicago.**—There is a notice in one of the recent numbers of the Journal of the new bacteriological laboratory established in Philadelphia, under the supervision of Dr. Bolton, of Johns Hopkins University. Your readers may not generally be aware of the efficient work in this line which has been carried on by Dr. Adolph Gerhmann, in the laboratory of the Health Department of Chicago, during the past year. For information upon this subject the reader may refer to the official reports. Dr. Gerhmann is an excellent bacteriologist, and for a long time he has been furnishing small boxes containing the requisite appliances for the collection and safe preservation of diphtheria cultures. These little boxes are furnished to medical practitioners of the city on application, and the diagnosis is promptly made at the laboratory and reported by telephone or otherwise. The physicians have very largely availed themselves of the arrangements for prompt diagnosis of this disease, with gratifying results. There is a menagerie of white mice, rabbits, Guinea pigs, etc. attached to the laboratory, for experimental inoculation, and an extended series of ex-

periments in the preparation of the anti toxines of diphtheria have been carried on.

But Chicago is a very badly governed city. It has the reputation of doing things on a large scale, which is borne out quite well in the extent of the rascality and corruption which permeates the city government. An overwhelming republican victory at the last city election ousted the spoilsmen of the opposite party, and substituted a mayor who is above all things, a politician. His latest official act is one which should be recorded in all scientific journals in the country. That the scientific world may know how highly scientific knowledge is recognised in this great metropolis, Dr. C. T. Reynolds, who has been an efficient Commissioner of Health, has been replaced by a certain Mr. Kerr whose qualifications for the position are that he has been an alderman and it was necessary to provide him with a position. In my opinion, Chicago should be made to feel the disgrace of this appointment. It should be resented by every medical man, by every person who believes that sanitary science deserves recognition by municipalities, and that an alderman is not the proper person to represent a city health department officially, or to be entrusted with the responsibilities of the position.

It is not to be supposed that the people of this city are oblivious to the disregard of their interests manifested by this appointment; or that the ludicrous side of it is not clearly seen. But there is also a serious side, which is of far greater importance. There seems to be nothing to be gained by protests, the Mayor having the power to do as he pleases, and the citizens must submit. The excuse is offered that a "business man" is wanted to direct the department. If, unlike the manner of Chicago politicians, the new Commissioner will only keep his hands off the scientific work of the laboratory, we may be thankful for that. The fear is, that the strictly business administration so greatly desired by the Mayor, may interfere with the scientific work so ably planned and conducted by Dr. Gehrman.—R. HITCHCOCK.

**MICROSCOPICAL SOCIETIES.****San Francisco Microscopical Society.**

*April 17, 1895.*—Dr. Carlson read a paper on anti-toxine. The discussion which followed the reading of this paper showed the popular interest, not only of medical, but other men. President Spencer said the newspaper notoriety given a certain fatal case treated with anti-toxine in the East was unfortunate, since the general public was easily influenced and formed hasty conclusions, without taking into account other attending circumstances. It is in line with the periodical newspaper scares about the danger from vaccination against small pox, where some unfortunate, with the germs of half a dozen deadly maladies in his veins, dies from one of them and not from the vaccine virus.

At the close of the discussion, a demonstration of section-cutting was held, and microtome sections to the thinness of one ten-thousandth of an inch were cut by the paraffine method and by the ether-freezing method. Members were very much interested in this demonstration by President Spencer, evidenced by their inquiries into the minutest details of the operation, and on adjournment expressed themselves highly pleased.

*May 1, 1895.*—John C. Spencer, M. D., President, in the chair. The routine business included the report of the receipt of valuable periodicals and papers, including the Journal of the Royal Microscopical Society, the Quarterly Journal of Microscopical Science, American Monthly Microscopical Journal, Nature, etc.

The society's cabinet was enriched by the receipt of ninety-nine vials of soundings made by the steamer Albatross between San Francisco and the Hawaiian Islands. These soundings are very rich in microscopic forms, such as diatoms, polycistina and foraminifera. The soundings are preserved in alcohol, the exact location with date and other memoranda accompanying them, and referred to by corresponding number, making this material of the highest scientific value. The soundings were made from July 1, 1891, to June 30, 1892, and the scientists

who are connected with the United States Commission of Fish and Fisheries are preparing an elaborate memoir, which will describe and figure the various forms there found. The Microscopical Society was placed in communication with Lieutenant-Commander Tanner by Colonel Kinne, one of its members, and the result of the correspondence was presented last evening. In view of the value of this donation to the society, a special vote of thanks was taken.

Dr. Eisen exhibited slides showing the blood of *Diemyctylus toroms* and other reptiles. The staining of these preparations leaves nothing to be desired.

The society decided to inaugurate a series of outings for investigation and study of the microscopical flora and fauna in the vicinity of San Francisco. A similar series two years ago was productive of good results and stimulated original research.

#### Lincoln Microscope Club.

*April 24, 1895.*—Mr. Hartley explained several points in an old microscope (made before 1800) recently deposited in the museum of the university.

Dr. Ward exhibited slides of intestinal trichina, and spoke briefly on methods of distinguishing trichina and similar parasites.

Dr. Bessey called attention to certain functions assumed by the fruits of the elm, ash, maple and other trees, and exhibited slides by way of illustration.

Mr. Elmore showed specimens of a nematode worm (*Oxyurus*) found in the intestine of a rabbit.

Mr. Pound called attention to the recently published Abstract of Minutes of the New Jersey State Microscopical Society. He also showed a curious fungus, *Helicosponicum vegetum*, Nees, recently found in the state.—ROSCOE POUND, *Secy.*

#### New Jersey State Microscopical Society.

*Monday, April 29.*—The members of the section on Botany spoke to an attentive audience at this meeting. The first subject was the "Development of the Spring Lily," by Mr. Fredk. H. Blodgett.

After mentioning the freshness of the field of subterranean

botany, he described the growth of the bulb of the spring lily (*Erythwinum*), illustrating the different stages by blackboard sketches. The means by which the small bulb found at shallow depths becomes the deep-seated two-leaved bulb bearing the flower were shown and illustrations of the structure of the blossom as found within the bulbs during the winter.

Dr. B. D. Halsted then spoke on "The Modern View of Lichens." By means of a series of charts he showed the structure of fresh water algæ, the development of the fungi on different hosts, and finally the form of vegetation which is produced when a fungus grows on an alga. The charts showed very clearly the delicate structure and coloring of the algæ and the tangle of fungous filaments as the alga becomes infested by the fungus and develops the different forms of lichens.

Mr. J. A. Kelsey described and showed specimens of some of the "Conspicuous Spring Fungi," speaking of the rusts of the Spring Beauty, the Shepherd's Purse, the Cedar and Pepper-root, and a smut on the Spring Lily. Slides under four microscopes illustrated the structure of the fungi which were spoken of.

The "Kola Nut" was the subject of Mr. F. B. Kilmer's talk. Specimens of the nut were distributed and drawings shown illustrating the structure of the starch and other portions of the nuts. Lantern slides showed the natives of the West Indies preparing the nuts for market; also the trees and fruit as seen in their home. The economic and chemical properties of the Kola were dwelt upon and showed the presence of a well-equipped chemical laboratory within the nut.

The next meeting will be in charge of the sections on Geology and Mineralogy.

*Monday, May 27.*—At the 26th annual meeting, the following officers were elected for 1895-6:

President, Byron D. Halsted, Sc. D.

Vice-President, Julius Nelson, Ph. D.

Recording Secretary, Frederick H. Blodgett.

Corresponding Secretary, John Helm, M. D.

Treasurer, A. C. Hutton, M. D.

Curator, A. H. Chester, Ph. D.

Librarian, Frederick H. Blodgett.

Trustee (two years), Fred. B. Kilmer.

The secretary's report showed an increase in general interest on the part of the members and an increase also in the attendance of visitors at the regular meetings.

The quarter-centennial was celebrated by a well-attended public meeting. The program of this meeting included the projection of micro-slides of rock sections, marine algæ, living animalculæ and wood-sections, and table exhibits from the three natural kingdoms under thirty-five instruments.

About a year ago the society was sectionalized and the following sections created:—

- |                      |                |               |
|----------------------|----------------|---------------|
| 1. Agriculture       | 5. Chemistry   | 9. Mineralogy |
| 2. Bacteriology      | 6. Entomology  | 10. Pathology |
| 3. Biology (Zoology) | 7. Geology     | 11. Physics   |
| 4. Botany            | 8. Histology   | 12. Technique |
|                      | 13. Literature |               |

Of these, the sections on Bacteriology, Botany and Mineralogy have had charge of one meeting each, and reports of less length have been made by the sections on Technique and Literature.

The membership includes 40 active, 19 corresponding and one honorary member.

After the business session was over, A. H. Chester, Ph. D., read a paper on "Crystals," describing the means used in the preparation of crystals for micro-mounts; slow crystalization from fusion, or solution, sublimation, precipitation and electrolysis. The paper described the systems of crystals to some extent, mentioning more especially those of gold, silver and copper. With the aid of ten microscopes, the minute beauties of the crystals were shown with appreciation to a goodly number of members and friends.

### Calcutta, India.

*Monday, February 11, 1895.*—Present, thirteen members and seventeen visitors. Shepherd John Leslie had come from Barrackpore bringing much apparatus in order to give a demonstration of his method of taking photo-micrographs with the microscope in a vertical position. He described the disappoint-

ments and tortures he had undergone in trying to use the instruments horizontally. He worked the instrument with Ilford's plates and in the meeting took photo-micrographs of the parasite of an ox (*Hæmatopinus eurysternus*), of the intestine of a mouse and of a slide of polycystina mounted for transmitted light. He also developed them in an improvised dark room with red light in the presence of the visitors. He then printed positives on glass on Thomas' lantern plates by exposure of three to six seconds at 18 inches from the kerosine lamp, and developed them with the same developer he had used for the negative, but considerably diluted. For these positives he had brought with him negatives of objects previously prepared. He showed slides printed from them, both by passing them around and by projecting them with the society's lantern, with a disc of three feet.

*Monday, April 8, 1895.*—Mr. Aitkin read an interesting *resume* of periodicals recently received by the librarian. The chairman then called on the lecturer for the evening to read his Note on Micro-fungi and their Air-borne Spores. Mr. Simmons commenced with a brief description of the yeast plant (*Torula cerevisiæ*), and explained, with the help of a sheet of diagrams, the method in which it is reproduced by *budding*. The action of the organism in producing fermentation was also dealt with, and the analogy between fermentation in organic fluids and zymotic diseases referred to. He next proceeded to describe three of the commoner forms of mould, viz.: *Penicillium glaucum*, *Aspergillus glaucus*, and *Mucor mucedo*, which form a greenish crust on old bread, cheese, jams, decaying fruit, etc. In an improvised moist chamber, specimens of mould were seen in active growth, and the method of making and studying "drop cultivations" was demonstrated.

At the close of the lecture, specimens of the yeast plant obtained from toddy and of the different moulds referred to, as well as of the spores of fungi and those found in dust, were exhibited under the microscope. The session has now closed. The midsummer session will begin with a meeting to be convened for July 8, and to be followed by others on August 12 and September 9 next.



LETTERS TO THE EDITOR.

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**Professor O. P. Phillips**, of the University of Southern California, writes in reply to our request that he express his opinion favorably to papers read at the American Microscopical Society being published in this periodical :

" I can get at least ten of my microscopical friends to join the association if this last suggestion is carried out. This is by actual canvas."

The suggestion to which he refers is as follows :

If instead of the Society collecting \$3 admission fee and \$2 annual dues from about 300 members, it were to collect no admittance fee and \$1 per annum from each member, it could have many more members. If instead of spending \$500 to \$600 in printing "Proceedings" it should appropriate \$100 for engravings to be used in the Journal, its finances would be in much better condition than now, and just as much of its publishing could be done. If it would appropriate \$360 for the publication of its papers in the Journal, this periodical could have three times the illustrations it now has and one and one-half times the present number of pages without any further increase in the subscription price.

**Dr. S. M. Mosgrove**, who was treasurer of the Society for many years, writes :

" Having had some experience in the past in publishing *Proceedings of the A. M. S.*, or rather in endeavoring to collect money to pay for the same, I think your scheme of publishing in the JOURNAL would be beneficial to both the JOURNAL and to the Society."

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NEW PUBLICATIONS.

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**The Monthly Illustrator**, published by Harry C. Jones, 92-94 Fifth Avenue, New York. \$3 per year ; single copies, 30 cents.

This is one of the finest of art educators. Each number contains between two and three hundred illustrations, including reproductions of sketches and paintings by celebrated artists, both in Europe and America. It contains valuable criticisms and descriptions, and illustrations of places of historic interest. The current issue gives views of the interiors of the studios of several prominent artists, studies of flowers and seaweeds as

used in decoration, illustrations of ancient pottery and other articles of archaeological interest. Heretofore there have been many interesting articles with original illustrations and by various artists. It is a periodical in every way worthy the careful perusal of all art lovers.

**The July Monist** contains two important articles on evolution. Prof. Joseph Le Conte, in the first article, entitled "The Theory of Evolution and Social Progress," reviews the history of the development-idea in all its phases, distinguishing four grades or planes of evolution—physical, chemical, biotic and human. To each there is a natural limit, and the evolutionary process can continue only by being lifted in each successive instance to a higher grade with new factors. The first three have already reached their goal; only the last, rational evolution, now remains. Here the signification and character of the new factor—voluntary rational co-operation—which differentiates the new grade from the rest, must be borne in mind in all sociological applications of the principle.

Prof. Le Conte points to the revolting consequences of the view which rejects the inheritance of acquired characters, and emphasizes the beneficent and encouraging features of the Lamarckian factors in social evolution. He counsels caution and a strict subordination to a wise empiricism in all political applications of scientific theories.

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### MICROSCOPICAL NOTES.

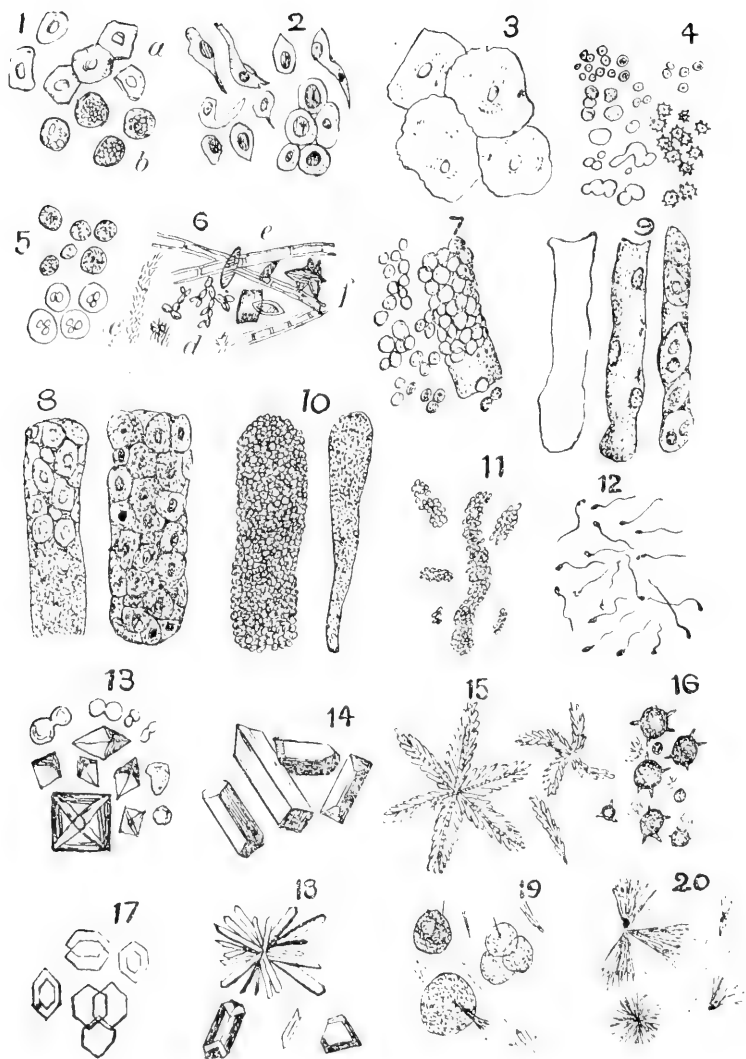
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**Which Book?**—Frank Edel in the Druggists Circular for July says:

Gage's Microscopical Methods is considered by many competent judges the best book in English on the subject. Clark's Practical Methods in Microscopy is also an excellent work and the writer believes that Microscopical Praxis by Stokes is very valuable as a book of reference. Carpenter's "The Microscope and its Revelations" is very complete and thorough. But for the uses of the student, Gage's book is much the best.

He might also say that Gage's is far less expensive than Carpenter's.





# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

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### Preparations for Urinary Examination.

(See *Frontispiece*.)

TO COLLECT A SPECIMEN.—Take a perfectly clean four-ounce bottle well stoppered with a new, clean cork. Direct the patient to first carefully cleanse the parts, then wash the urethra by permitting a little of the urine to escape, and collect the remainder in a sterilized bowl or glass from which it should immediately be poured into the bottle and corked. No vessel should be used which has been used for the purpose before. If the specimen is not to be used immediately, the bottle in which it is to be placed should be sterilized by either boiling in water for five or ten minutes or baking in the oven for sometime. In this way, if sufficient care be taken, specimens may be kept for days or weeks without deterioration.

The best results are obtained from a mixture of the urine passed immediately after rising in the morning and that passed on retiring.

On receipt of the specimen to be examined microscopically, three or four ounces should be poured into a very clean conical glass, which should be covered with a paper cap to prevent the entrance of dust and dirt of any kind. This should then be set aside to stand undisturbed for eight or ten hours in order that any morphological constituents may subside. Even with the greatest care in collecting and handling, foreign matter such as fibers of

wool, cotton, silk, wood, etc., are likely to gain entrance, so it is of the utmost importance that the observer be familiar with the appearance of all such common objects before deciding upon the character of the urinary deposit.

With a pipette, which has been carefully cleansed and sterilized, a small drop of the deposit is placed on the center of the slide and covered with a thin glass. If too much fluid has been dropped to hold the cover-glass in place, the slide should be put aside for a little while or until sufficient evaporation has taken place to permit it to be turned on its edge without slipping the cover. Care should be taken that no pressure is made upon the cover, lest the object to be studied be unduly compressed. It is really necessary sometimes, especially when the deposit contains renal casts of large size, to give support to the cover-glass to prevent compression. This may be easily accomplished by placing on either side of the drop a bit of a fine hair, say a half inch in length, which will answer instead of a shallow cell, if not better. If the sediment is stained before the drop is placed on the slide it will greatly facilitate the examination. To do this take a pipetteful of the sediment and transfer it to a small vial, add a drop or two of the aqueous solution of safranin and shake for a few moments. This stains all organized matter.

**EPITHELIAL CELLS.**—Although much has been said about the different kinds of urinary epithelium, there is not difference enough to say of a certainty that this flattened, tessellated form comes from the renal pelvis (fig. 1 a, healthy, b, fatty), or that, that flattened or pyriform cell is from the bladder (Fig. 2), for unfortunately in practical work there is no such sharp distinction; but it is true that the superficial layers of the mucous membrane furnish epithelial cells of polygonal or elliptical shape with a single large nucleus and granular proto-

plasm, while those from the middle and deeper layers are of rather an oval shape, sometimes running into the long protoplasmic tails or processes having also a single large nucleus and granular protoplasm, yet all this is not absolute proof.

In diseases of the vagina and uterine cervix, the deposit is loaded with large pavement epithelial cells which are found lying in masses overlapping one another (fig. 3). Kidney cells loaded with fat (fig. 1 b) indicates fatty degeneration in renal tissue, but a differential diagnosis cannot be founded upon these cells alone.

RED BLOOD CORPUSCLES are often found in large quantities indicating hemorrhage. When few in number, shrunken in appearance, of a pale yellowish color looking more like washed out rings than normal red blood cells, there is ground for suspicion that the blood was effused in the kidney, pointing either to acute nephritis or tuberculosis (fig. 4).

PUS-CELLS may be easily recognized with the microscope. They are about one-third larger than a red blood corpuscle and colorless. They are made up of cell-walls, granular contents, and nuclei (fig. 5). Add a drop of acetic acid and the cell wall becomes quite transparent and the nuclei more decided. If of doubtful identity, it may be quickly dispelled by either the *iodo-potassic iodide solution* or Vitalis guaiacum tincture test. The former colors the cells a deep mahogany brown and the epithelium with which they are occasionally blended a light yellow; the latter gives a deep blue tint.

CASTS.—There are two kinds of Casts, Unorganized and Organized. The former includes False-Casts and those formed of crystals and urates. Pathologically these have but little significance.

The latter includes those derived from the loops of Henle and the collecting tubes of the kidney: (1) Blood-casts, consisting of coagulated fibrin enclosing

blood-corpuscles (fig. 7). They are soluble in acetic acid. (2) Epithelial casts, made up of columnar epithelium or of round cells (fig. 8). (3) Hyaline casts are made up of a translucent, homogeneous, slightly refractive, and often barely visible, flexible, proteid material (fig. 9). They are unaffected by acetic acid. (4) Waxy casts, are made up of very refractive and brittle proteid matter. As a rule they are longer than the others, somewhat resembling a segment of the tape worm. They are so often found broken after leaving the kidney, that in the microscopic field they are seen in short fragments, notched and bearing upon their surface white and red blood corpuscles, fatty globules, arranged separately or in confluent masses, either a coating of urates or dotted with crystals of various kinds, and fungi. (5) Granular casts are dark opaque bodies composed of granular material and covered with granular cells. They differ much in character and no positive diagnosis can be formed upon them alone. They may be of all shades, from pale yellow to reddish brown. They are usually seen in fragments of various lengths and widths with well defined borders, but the bodies are variously tapered and bent (fig. 10), they are sometimes coated with pus-cells, fatty globules and crystals. (6) Fatty casts are highly refracting bodies made up of epithelial, hyaline, waxy or granular casts, filled with fatty globules.

UREA.—This is the most abundant and most important of the organic constituents of urine. To determine the presence of urea, take an inch of a small thread of cotton, dip one end into the urine and place it with its hanging drop at the center of a slide, then cover with a thin glass leaving half of the thread free. Upon this free end let fall a minute drop of nitric acid and place the slide under the microscope. The formation of the plate crystals will afford an interesting field.

Among other interesting things which urine may con-



tain are spermatozoa (fig. 12); tubercle bacillus (fig. 6, c); urates; mold (fig. 6, e); crystals of uric acid (fig. 6, f); yeast (fig. 6, d); oxalate of lime (fig. 13); stellate crystals of triple phosphate (fig. 15); ammonia magnesium phosphate (fig. 14); acid ammonium urate (fig. 16); cystin (fig. 17); hippuric acid (fig. 18); leucine (fig. 19); tyrosin (fig. 20); and acid sodic urate in cylinder (fig. 11).

We are indebted to "Medical Microscopy," by J. E. Reeves, M. D., for the information and illustrations contained in this article.

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### Microscopical Technique Applied to Histology.—X.

[FROM THE FRENCH OF RENE BONEVAL.]

(Continued from page 239, August 1895.)

#### THE LUNGS.

The endothelium of the air cells may readily be seen in the lungs of a recently killed animal.

1. Select the frog. In this exceedingly simple lung the arrangement of the epithelial cells may be seen in all their simplicity. Open the abdominal cavity after cutting the medulla oblongata; by a pipette in the glottis inject into the lungs a 1 to 300 solution of silver nitrate. Close the pipette with the finger to keep the lungs distended, and expose to the sun. When the lungs are colored brown, remove them and slit them open under water. Stain the nuclei of the endothelial cells with alum carmine, carefully extend the lung on a slide, inner face upward, and partly dry by the method already described. Dehydrate in absolute alcohol with many renewals; clear with oil of bergamot and mount in balsam.

2. A slight modification of this method is needed for the endothelium of the lungs of mammals. Open the

thorax of a rat or of a rabbit and let the animal die by asphyxia. By the trachea inject a 1 to 300 solution of silver nitrate so as slightly to distend the lungs. Expose to the sun till opalescent, remove the solution and lightly press the organs. Expand the lungs through the trachea (by the breath), ligate, and suspend the distended organs in a dry place. After 24 or 48 hours of drying, section parallel with the surface and mount in balsam. . . . .

Preparations described for the study of the capillary circulation and of the endothelium of the arteries should not be neglected.

*Natural Injection.*— . . . . Open a living frog, so as to expose the lungs, and in a few minutes, when the organ is congested, put a ligature around the base and place the distended organ in 2 per cent bichromate. In 24 hours slit open the lung, leave it for a few hours longer in the fixative, then carefully extend it on a slide, inner surface upward. Stain by hæmatoxylin and eosine; mount in balsam. . . . .

*Injection by Colored Mass.*—The soluble Prussian blue mass is to be preferred. Inject by the pulmonary artery and treat like other similarly injected specimens.

#### URINARY ORGANS.

*The Kidney.*—The technique of the kidney presents difficulties so that we must make several preparations to show separately the constitution of the numerous elements entering into the composition of the organ. After studying the technique applicable to sections of the renal tissue, we shall study the epithelium of the convoluted tubes, the structure of the glomerule, the intertubular spaces, and the methods of injecting the uriniferous tubes and the blood vessels.

*Sections.*—We advise against the use of alcohol as a fixative, as it produces alterations and prevents staining.

Ammonia bichromate and osmic acid furnish the best results. . . . . With a very keen razor cut a cube 1 centim. in diameter, taking care not to compress it. From this cube take a strip 1 mm. thick, place it in 1 per cent osmic acid ; put the rest of the cube in ammonia bichromate.

The piece in the osmium solution should remain for 24 hours. Wash carefully, harden in gum and alcohol. Section perpendicular to the surface of the organ, stain in alum carmine, mount in glycerine. The piece in bichromate should be left there for at least from 8 to 10 days. Wash, harden in gum and alcohol, stain in hæmatoxylin and eosine, mount in balsam. Make two series of sections, one parallel with the surface of the organ, the other perpendicular.

*Epithelium of the Convolute Tubes.*—If fixed by alcohol, by the bichromates or even by osmic acid, these produce alterations. . . . . The striation of the cells is scarcely visible, the cell contracts and expels into the tubule one or more sarcodic masses. The epithelium is striated and hollowed by vacuoles, which give it the aspect of cup-shaped cells. The following rules are to be followed for the examination of the striation in the kidney of mammals. (1) Take the kidney from an animal immediately after death. (2) With a very keen razor, cut near the surface a slice 1 mm. or more on a side. (3) Fix by osmic acid vapor (2 hours), place in strong alcohol (without washing) to complete the hardening. (4) Examine sections in water.

The striated cells in the kidneys of the Batrachia having more resistance than those of mammals, the preceding technique will not be necessary to see the striæ. Put the kidney of the frog, or better that of the triton, in absolute alcohol ; when hardened, section very thin so that you may examine in the staining fluid. The striæ of the cells are very distinct.

It is possible to isolate the epithelial cells, as follows: Cut open, through the middle, a frog's kidney which has been macerating for 24 hours in weak iodised serum. With scissors remove a piece and agitate it in a drop of picro-carmin. A crowd of perfectly isolated cells may be thus obtained.

*Endothelium of Bowman's Capsule.*—To demonstrate this, impregnation by silver nitrate must be resorted to. A rabbit is killed by cutting the medulla; the belly is opened and the artery and the emulgent vein with the ureter are carefully isolated. Into the artery inject artificial serum (physiological solution of salt, as follows: Water, 1000; common salt, 7 grms. 5), to expel the blood without changing epithelium. We know that epithelium and, in general, other parts, will live for sometime in artificial serum. When the liquid, injected very gently, returns colorless through the vein, substitute for the serum a stream of distilled water. The salt is rapidly expelled and, if we act with sufficient celerity, the water will not change the epithelium. Then pass through the kidney a stream of silver nitrate, 1 to 500. The organ at once whitens at points; a few minutes are enough for a sufficient impregnation. . . . . End the operation by passing another stream of distilled water, tie the artery, vein and ureter; suspend the kidney by the ureter in about 300 grms. of alcohol at 90 °c. The alcohol rapidly coagulates the surface of the kidney; . . . . . the injected vessels, the capsule of Bowman, the cortical portions of the systems of convoluted tubes no longer contract, and the hardening progresses so regularly that in 24 hours thin regular sections may be cut of the medullary and of the cortical substance. The sections mounted in glycerine or in balsam show the vessels, the glomerules, Bowman's capsules and the origin of the convoluted tubes at once impregnated with the silver, and distended as if they had been inflated.

This preparation will demonstrate the layer of protoplasm clothing the surface of the glomerule. A rabbit's kidney is injected with Prussian blue (the method will be described hereafter), fixed by 2 per cent bichromate (be sure to slit the kidney in many places after the injection mass is cold, so that the fixative may penetrate more readily), harden in gum and alcohol. Cut very thin sections either parallel with the surface or with the medulary radiations. Stain in picro-carmin (24 hours), or by Magdala rose (a few drops of a saturated alcoholic solution in a glass of water). Preparations injected with blue, stained in Magdala rose are to be examined in water; the nuclei proper of the capillaries being drowned by the blue mass, the nuclei of the cells enveloping the glomerule are stained pure violet, the protoplasm of the cells amaranth rose.

*To Inject the Blood Vessels.*— . . . . . When injecting the sub-diaphragmatic part of a rat's body the kidneys are often injected in a remarkable way. Remove one, slit it and put it in the ammonia bichromate. In 8 or 10 days wash, harden in gum and alcohol, section, stain in alum carmine, mount in balsam. It is well to make transverse and longitudinal sections.

*To Inject the Uriniferous Tubules.*—This is an exceedingly delicate operation, usually successful only after repeated trials.

*Chrzonczewski's Method.*—This consists in injecting into the animal's blood a coloring matter to be eliminated by the kidneys (distilled water, 30; carmine, 3; ammonia, 1.50). Forcibly immobilise a rabbit, lay bare the jugular vein upon which place a ligature, and open the peripheral end. Allow from 15 to 20 grms. of blood to flow, tie the peripheral end and inject by the central part 15 to 20 grs. of the carmine solution. In an hour open the abdomen, tie the ureter, open the renal artery and vein, and inject through the artery a solution of

common salt, 1 to 200. Soak in absolute alcohol, and make transverse sections.

*Injection of the Ureter.*—This operation, even more difficult than the preceding, can be performed on the dog. Remove the kidney from a recently killed animal, taking care to preserve the end of the ureter, and inject the Prussian blue mass without gelatine, tying the canula in the ureter. Pressure should be very slight. . . . Put the organ in bichromate, harden in gum and alcohol. There are often a few points in the kidney which are properly injected.

*The Ureter; Dissociation of Epithelial Cells.*—Open a segment of ureter and macerate it for 24 hours in the  $\frac{1}{3}$  alcohol; scrape the internal surface with a scalpel, and spread the result in a drop of the  $\frac{1}{3}$  alcohol. Stain by picro-carmin, mount in glycerine.

*Sections.*—Make longitudinal and transverse sections of the organ fixed by alcohol, and hardened in gum and alcohol; stain in picro-carmin.

*The Bladder.*— . . . . . In the frog tie the opening of the cloaca with a strong string, open the abdomen and seek the terminal end of the large intestine. Gently inject the tube. The liquid collects in the cloaca and is forced into the bladder. When that organ is properly distended, tie the large intestine, detach the posterior members of the frog with the bladder and the intestine, and place the whole in a large quantity of the liquid used to make the injection. . . . .

Inject with the  $\frac{1}{3}$  alcohol; in 24 hours scrape the inner surface with the scalpel, spread the result on a slide in a drop of the  $\frac{1}{3}$  alcohol. Stain in picro-carmin, mount in glycerine. (*Isolated Epithelial Cells.*)

*Muscles.*—The preceding bladder from which the epithelium has been carefully brushed, should be spread on a slide, inner surface upward. Stain by hæmatoxylin and eosine; mount in balsam.

*Vessels.*—Inject a frog with silver nitrate, 1 to 300, as has been described for the vessels of the lungs. Fill the bladder with the  $\frac{1}{2}$  alcohol, brush away the epithelium and mount the bladder in balsam, the inner surface upward, after exposure to direct sun-light.

*Nerves.*—Inject into the bladder lemon juice, then 1 per cent gold chloride. Reduce in the  $\frac{1}{4}$  formic acid and examine flat. Consult, for this manipulation, the technique described for the study of nerve endings in the unstriated muscles.

*Sections.*—Inject into the bladder 1 per cent osmic acid. In a few minutes, the walls being fixed in an extended state, open the bladder, and put it for  $\frac{1}{2}$  hour in the osmium solution. Wash, harden in gum and alcohol; section, stain with alum carmine, mount in glycerine.

It is very easy to inject the bladder of mammals to fix it in an extended condition. Place the canula in the urethra, and open the abdomen, being careful not to wound the bladder. Force the injection in strongly, and when the distension is sufficient, ligate the base of the organ and dissect out the bladder beyond the ligature.

*Epithelium.*—Inject with the  $\frac{1}{2}$  alcohol, and follow the method given for the epithelium of the frog.

*Sections.*—Inject with 95° alcohol and put the organ in 50 centim. of the same alcohol. In 24 hours open the bladder and harden in gum and alcohol. Section, stain in picro-carmine, mount in glycerine. It is necessary to take the bladder of a recently killed animal, otherwise the epithelial layer will not be present in the sections. The rabbit's bladder is an excellent object for study.

#### THE SKIN.

The skin being contractile under the action of reagents, it is necessary after it has been properly extended and held in position, to fix it by the methods given for

the study of membranes. This is especially applicable when the fixation is by alcohol or by the bichromate. When osmic acid is used, the piece of skin being very small and the action of the fixative rapid, there is no need of observing those conditions. We should here repeat what has been so often said, that the skin should be perfectly fresh, if possible the result of an operation. It should be taken from different parts of the body so as to observe the modifications presented by the layers composing it.

*To be Continued.*

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### The Use of Filtered Water in Microscopic Manipulation.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

I always use filtered water in microscopic manipulations, for filtered water is better than distilled water. We may use distilled water and introduce minute organisms into the field which will thereafter become extremely puzzling and mar the investigation irretrievably. These may be introduced in the funnel or vessels used. But if the funnel and vessels are wiped dry before using, of course there is not a danger of introducing extraneous substances. I find that if water for washing is used immediately it is best; for spontaneous generation, if it be present, seeds or eggs, cannot have time to develop. Mr. Kitton some time ago noticed that water passed through a filter developed Bacillariaceæ if permitted to stand.

In washing infusorial earths that contain spicules of sponges, Foramenifera, Radiolaria or Bacillariaceæ, the calcareous or silicious organisms must be eliminated. The Foramenifera being calcareous are difficult to keep clear and must be viewed separately by the microscope. But we have to use filtered water to prevent the minute organisms present in all other water from being intro-



duced into the solutions, and thus mar the result, aimed at when employing the high magnifying glasses of the microscope. Distilled water alone will not do, for even then the little Bacillariaceæ will creep in and puzzle the observer. A dozen Bacillariaceæ do not weigh enough to influence the balance but are enough to see. I have used filters of various kinds, but paper filters are the most convenient. To support them a funnel of glass or similar hard material is used. To facilitate the flow a ribbed funnel has been tried, but this is inconvenient. The flow of the water is too slow, and much of the filter is lost, being left out on account of the adherence of the funnel. A funnel was tried, but that did not answer, being rusty and offering a small portion to the flow. At last I did away with the funnel altogether. I now use what I think is a decided advantage. A piece of celluloid, such as is used for taking photographs on, and which is made of collodion mixed with gum camphor, is taken and bent around in the form of a funnel, and placed in an iron retort stand ring. Into this the paper filter can be placed. The celluloid is thin, and can have holes punched in it all over so that it becomes a sieve. Most of the filter can thus be made use of, and when it is not in use the celluloid strip can be washed clean and put away flat like a sheet of paper. I hope this simple contrivance will be appreciated by all if it is only tried.

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### Diatoms of the Connecticut Shore---VIII.

By WM. A. TERRY.

BRISTOL, CONN.

*Continued from Page 41.*

The small naviculoid diatoms mentioned in No. 7 of this series, may be found on the soft ooze uncovered by the tide in almost every bay, cove or inlet of the Connecticut shore, especially in early summer; later in the season the mud of sheltered ditches when laid bare by

the recession of the tide may be often found covered by a brown film of similar living diatoms, not always of the same shape, but belonging to the same stage or period in the life history of the diatom. In the autumn the ditches of the salt marshes may be seen covered by a thick film of floating algæ of a yellowish green or a brownish color, frequently consisting chiefly of *Oscillaria* (*Oscillatoria*), and containing vast numbers of active spore-like organisms, of various shapes and sizes. Many of these do not in the least resemble the diatoms in their outlines, but are precisely similar to them in the color of their endochrome and in the character of their motions, and behave exactly like the above mentioned small diatoms when subjected to chemical treatment; all alike being destroyed not only by acids and alkalies but also by boiling water, and all alike also dissolve and disappear when mud containing them is dried. I have no doubt that all these represent the early stages in the growth of diatoms from spores; but my attempts to demonstrate this by cultivation have failed, because I was unable to protect them from their devourers, and give them sufficiently natural conditions for their development. The motions of the *Oscillaria* are very interesting, and show some points of resemblance to those of diatoms. In 1889 in an article in this Journal, I pointed out the fact that their proper motion was a revolution upon their axis, advancing or retrograding according to whether the revolution was to the right or to the left. In all previous accounts which I had seen their motion was described as waving or nodding. Prof. Harvey in his "*Nereis Boreoli Americana*," page 97, says, "These movements are of three kinds: First, there is the oscillating movement; one end of the thread remaining nearly at rest, while the other swags from side to side, sometimes describing nearly a quarter of a circle in a single swing: Secondly, the tip of the filament has a minute movement, bending

from side to side, like the head of a worm, and, thirdly, there is an onward movement, probably the result of the two former." As the filament has a rigid sheath of cellulose it must be credited with an extraordinary muscular development if it was able to bend the tip "from side to side like the head of a worm." A closer examination would have shown that the tip was rigidly bent to one side, and that the change in position was caused by the revolving motion, forcing it forward in a spiral path through the water. The waving motions are caused by tension; the elasticity of the filament causing it to spring out when working itself free from obstructions.

The desmids also resemble the diatoms in some particulars, and have a peculiar motion not often seen; some of them move end-ways like the *oscillaria*, the *Closterium fastens* one end and then swings the other around abruptly, sometimes describing a half circle in one swing; the *Micrasterias*, *Cosmarium* and *Euastrum* have a peculiar jiggling motion, waddling along like a duck, as if they were advancing on two short legs placed near their centers. The natural habitat of both desmids and *oscillaria* is in fresh water, but the *oscillaria* are found in abundance in the ditches of the salt marshes; these ditches are sometimes very nearly fresh, but certain marine organisms appear to accommodate themselves to the change, and some species of marine diatoms are found far up the rivers where the water is entirely fresh, and certain species of *oscillaria* are found most frequently in water that is more or less salt. *Spirulina tenuissima* is frequent in the ditches of the marsh between Morris Creek and South End. This variety has the most rapid revolving motion of any that I have observed, making two or three revolutions each second; but its onward progress does not correspond in rapidity with the rate of revolution. In these ditches, and also in Morris Creek, I find a very large variety that I have

never seen described or figured; it is as large as *O. imperator* and is apparently divided into separate cells somewhat resembling the filamentous desmid *Hyalotheca dissiliens*. These cells vary in size, giving the filament an irregular outline; it is colorless or hyaline, with small and irregular opaque patches here and there; these spots make the revolving motion perfectly obvious to any observer, and its large size and rapid motions make it a remarkable object for observation. I have never found it in masses, but always in separate filaments, traveling over the surface of the mud at the bottom of several feet of water, in company with *Pleurosigma* and other diatoms.

The reproduction of desmids and oscillaria, like that of other algæ, is conceded to be by means of sexual conjugation and formation of a sporangium, whose contents afterwards separate into spores forming the starting point of a new generation. The diatoms also form a sporangial frustule whose valves, in all cases that I have observed, are not only much larger than the parent valves but are different in structure, and the upper and lower valves are unlike; in this respect resembling the *Achnanthes*. I have no doubt that the contents of these frustules form spores in a similar manner; many facts that I have observed would seem to prove this beyond question, but this not the place for an extended argument on this subject.

The pond holes in the salt marshes are of two classes, the first has a soft bottom of fine grained mud which extends down to the ancient deposit below; these pond holes are invariably rich in diatoms and frequently contain species that cannot be found elsewhere, and sometimes entirely different from those of neighboring waters. These pond holes are the remains of open water which once covered the site of these marshes; in those that are quite salt the mud is usually intensely black,

and these pools are very often rich in the very large *Pleurosigma balticum*, var. *maxime*. The pools further back that are fed by springs and are nearly fresh, contain brown mud, and in them may sometimes be found *Pleurosigma terryanum*; I have found five such pools on the Conn. shore many miles apart, in which this *Pleurosigma* may be gathered nearly pure; with this may often be found *Surirella striatula*, *Navieula maculata* and *N. permagna* with *Nitzschia scalaris* and many species of *Amaphora* and *Amphiphora* and smaller species in abundance. The second class of pond holes are sometimes larger than the first, but are shallow and the bottom is formed of peat; these show where the sea is recovering possession of the marsh by the subsidens of the coast, and are recent formations; they seldom contain large diatoms.

In exploring the marshes for diatoms it is necessary to go at low tide. While collecting I generally visit them day after day for weeks, bringing in a mass of material each day of from ten to twenty pounds in weight, and in making soundings in the bays and coves a much larger amount of material has to be examined. A preliminary examination will frequently show the general character of the gathering, but a thorough cleaning of each sample is necessary to determine the species contained in each. The amount of labor involved in this work can only be appreciated by those who have had practical experience in it. It is a simple matter to pick up a tuft of sea-weed on the beach and from it to make out a formidable list of species, while the whole amount obtained may not be enough to make a half dozen slides. It is a very different thing to clean and examine such a mass of material collected systematically from every part of the locality and from different depths of water. Notwithstanding the care with which I have gone many times over the ground I have no doubt but that it might

be possible to obtain gatherings containing entirely different species from any that I have found. As I have written before, the complete literature of the subject is not accessible to me, and although I find many kinds not described in such books as I have, I do not know that they are not described in others. From my own experience I think it would be possible to more than double the list of North American species given in Wolle's book by anything like a thorough investigation. In the Morris Cove soundings, made several years ago, were many unfamiliar kinds, among them was one belonging to the *Navicula elliptica* series, which was curiously constricted or shrunk on one side. In my correspondence with Dr. Ward at that time about these species, he refers to this one as "the little lopsided fellow." In the Silver Sands and Savin Rock material mentioned in former article, are several related forms; one appearing to be a variety of *Navicula Smithii*, another of *N. fusca*, another is still more elongated and with much finer striae; all these are constricted and bent similarly to the *N. elliptica* var. from Morris Cove. With No. 21 of "Le Diatomiste" was sent out Prof. Brun's "Diatomees" for April and May, 1895; in this I find figured and named the Morris Cove variety, p. 97, fig. 93, *Diploneis didyma* Ehe., var. *obliqua*, J. Brun, Morris Cove, Conn., U. S. A. Other new varieties credited to Morris Cove are pl. 16, figs. 54 and 55, "*Mastogloia gibbosa*, J. Brun," and figs. 84 and 85 "*Achnanthes curvirostrum*, J. Brun;" figs. 86 and 87, "*Achnanthes manifera*, J. Brun;" pl. 17, figs. 99 and 100, "*Navicula (Lybellus) tubulosa*, J. Brun;" figs. 109 and 110, "*Hanschia segmentalis*, J. Brun." It seems to me that Prof. Brun's figure of "*Diploneis obliqua*" is not so much constricted or bent as are the typical forms which are abundant in the material. As I cleaned up and examined probably 100 times as much material as that I sent to M. J. Tempere; and from many other

places and depths of water in Morris Cove, all of which varied greatly in contents, it is probable that many other unfamiliar forms noted are also new. I give a partial list of species found in one sample of the deposit beneath the marsh near Silver Sands. I omit all those of whose determination I feel uncertain and also most of the minute varieties.

Actinocyclus barkleyi, Grun.	Melosira sculpta, K.
“ crassus, Sm.	“ suleata, K.
“ ehrenbergii, Ralfs.	“ undulata.
“ triradiatus, Roper.	Navicula brevis, Greg.
Actinoptychus areolatus, Schm.	“ crucicula, Sm.
“ undulatus, E.	“ elliptica, K.
Amphiprora conspicua, Grev.	“ formosa, Greg.
“ lepidoptera, Greg.	“ fusea, A. S.
“ pulchra, Bail.	“ lyra, E.
“ vitrea, Sm.	“ latissima, Greg.
Amphitetras antediluviana, E.	“ humerosa, Breb.
Amphora euleinsteinii, Gaun.	“ interrupta, K.
“ intersecta, A. L.	“ peregrina, E.
“ laevis, Greg.	“ prateata, E.
Auliscus celatus, Bail.	“ pusilla, Sm.
“ pruinosis, Bail.	“ smithii, Breb.
“ radiatus, Bail.	“ theta, Cl.
“ sculptus, Ralfs.	Nitzschia, acuminata, Sm.
“ macranus, Grev.	“ circumscuta, Bail.
Biddulphia aurita, Breb.	“ scalaris, Sm.
“ laevis, E.	“ sigma, Sm.
“ pulchella, Gray.	Pleurosigma affine, Grun.
“ rhombus, Sm.	“ balticum, Sm.
Cerataulus polymorphus, E.	“ decorum, Sm.
“ turgidus, E.	“ wansbeckii, Donk.
Campylodiscus echeneis, E.	Podocystis americana, Bail.
Coscinodiscus apiculatus, E.	Pyxilla baltica, Grun.
“ excentricus, E.	Raphoneis amphyceros, E.
“ oculus iridis, E.	Rhabdonema adriaticum, K.
“ radiatus, E.	“ arcuatum.
“ lineatus, E.	Stauroneis aspera, E.
“ subtiles, E.	Surirella febegeerii, Lewis.
Coconeis scutellum, E.	“ gemma, E.
Cyclotella stylonum, Br.	“ striatula, Turpin.
Epithemia musculus, K.	“ fastuosa, E.
Melosira borreieri, Grev.	Triceratium favus, E.
“ nummuloides, Ag.	

The above list includes scarcely one-half the varieties I find in a single sample of this deposit; other strata contain many other species, but I have no time at present to make out a list of them.

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### The 18th Annual Meeting of the American Microscopical Society.

The 18th annual meeting of the society was held in the buildings of the Cornell University at Ithaca, N. Y., August 21-23. The meeting was in every way a very successful and enjoyable one. Thirty-two papers were presented. Of these seven were devoted to botanical, ten to zoological and histological subjects, and fifteen to the microscope or its accessories and the preparation and mounting of microscopical material. The entertainment possible at such a place was made the most of by the members. The magnificent library of the University, collection of botany, zoology and entomology were freely open for inspection.

#### WEDNESDAY MORNING.

The open session was held in McGraw Hall, Wednesday morning, August 21, at 10 a. m., with President Gage in the chair. The visiting microscopists were heartily welcomed by Hon. D. F. Van Vleet, of Ithaca, who spoke of the facilities which would be afforded the members for scientific work. Prof. Gage made an appropriate response.

The reading of papers was next taken up, of which space does not permit us to give abstracts. The following list was presented and discussions followed by members of the society:

Some notes on alleged meteoric dust, by Magnus Pflaum, of Pittsburg, Pa.

Corky outgrowth of roots and their connection with respiration, by H. Schrenk, of Cambridge, Mass.



A practical method of referring units of length to the wave length of sodium light, by Prof. Wm. A. Rogers, of Waterville, Me.

Some peculiarities in the structure of the mouth parts and ovipositor of *Cicada septendecim*, by Prof. J. D. Hyatt, New Rochelle, N. Y.

The lateral line system of sense organs in Amphibia, by Dr. B. F. Kingsbury, Defiance, O.

Comparison of the fleischel, the gower and the specific gravity method of determining the percentage of hemoglobin in blood for clinical purposes, by F. C. Busch and A. T. Kerr, Jr., Buffalo, N. Y.

The history of the sex-cells from the time of segregation to sexual differentiation in *Cymtogaster*, by Prof. C. H. Eigenmann, of Bloomington, Ind.

#### WEDNESDAY AFTERNOON.

The afternoon was devoted to the inspection of the library and other University buildings. One of the most enjoyable incidents was the witnessing of the making of micrometers with a Rogers ruling engine in the department of physics. For this the society is indebted to Prof. Moler of that department.

#### WEDNESDAY EVENING.

There was a large attendance at the evening session, which was held in the botanical lecture room, the occasion being the annual address of the President, Prof. Simon H. Gage of Cornell University. Prof. Gage took for his topic "The Processes of Life Revealed by the Microscope; A Plea for Physiological Histology."

As this paper will probably be published in full in a subsequent issue of the JOURNAL, we give only a few brief extracts here:

"It is characteristic of the races of men that almost at the dawn of reflection the first question that presses for

solution is this one of life; life as manifested in men and in animals and plants around them. . . . .

"This address is therefore to deal, not with life itself, but with some of the processes or phenomena which accompany its manifestations. But it is practically impossible to do fruitful work according to the Baconian guide of piling observation on observation. . . . .

"At the very threshold of any working hypothesis for the biologist, the question as to the nature of the energy we call life must be considered. The great problem must receive some kind of a hypothetical solution. What is its relation to the energies of light, heat, electricity, chemism and the other forms discussed by the physicist? Are its complex manifestations due only to those or does it have a character and individuality of its own? If we accept the ordinarily received view of the evolution of our solar system, the original fiery nebula in which heat reigned supreme, slowly dissipating part of its heat, and hurled into space the planets, themselves flaming vapors, only the protons of the solid planets. As the heat became further dissipated there appeared in the cooling mass manifestations of chemical attraction, compounds at first gases, then liquids, and finally, on the cooling planets, solids appeared. Lastly, upon our own planet, the earth, when the solid crust was formed and the temperature had fallen below the boiling point of water, the seas were formed and then life appeared. Who could see, in the incandescent nebula, the liquids and solids of our planet and the play upon them of chemism, of light, heat, electricity, cohesion, tension and the other manifestations so familiar to all? And yet, who is there that for a moment believes that aught of matter or energy was created in the different stages of the evolution? They appeared or were manifested just as soon as the conditions made it possible. So it seems to me that the energy called Life manifested itself upon this planet

when the conditions made it possible, and it will cease to manifest itself just as soon as the conditions become sufficiently unfavorable. It was the last of the forms of energy to appear upon this planet, and it will be the first to disappear.....

“As life goes on and works with power where the unaided eye fails to detect it, the microscope—marvelous product of the life energy in the brain of man—shows some of these hidden processes. It has done for the infinitely little on the earth what the telescope has done for the infinitely great in the sky.

“Let us commence with the little and simple. If a drop of water from an aquarium, stream or pool is put under the microscope many things appear. It is a little world that one looks into, and like the greater one that meets our eye on the streets, some things seem alive and some lifeless. As we look we shall probably find, as in the great world, that the most showy is liable in the end to be the least interesting. In the microscopic world there will probably appear one or more small rounded masses which are almost colorless. If one of these is watched, lo, it moves, not by walking or swimming, but by streaming itself in the direction. First a slender or blunt knob appears, then into it all of the rest of the mass moves, and thus it has changed its position. If the observation is continued, this living speck, which is called an *amœba*, will be seen to approach some object and retreat; indeed, it comports itself, as if sensitive, with likes and dislikes. If any object suitable for food is met in its wanderings the living substance flows around it, engulfs it and dissolves the nutrient portions and turns them into its own living substance; the lifeless has been rendered alive. If the eye follows the speck of living matter, the marvels do not cease. After it has grown to a certain size, as if by an invisible string, it constricts itself in the middle and finally cuts itself in

two. The original amœba is no more; in its place there are two. Thus nearly at the bottom of the scale of life are manifested all the fundamental features, the living substance moves itself, takes nourishment, digests it and changes non-living into living substance and increases in size; it seems to feel and avoid the disagreeable and choose the agreeable and finally it performs the miracle of reproducing its kind, of giving out its life and substance to form other beings, its offspring.....

“The processes and phenomena by which a new individual is produced are included under the comprehensive term, Embryology.

“All organisms, great or small, are but developments of minute germs budded off by the parent or parents, and the way in which these minute beginnings develop into perfect forms like their parents can only be followed by the aid of a microscope. Indeed, in no field of biology has the microscope done such signal service in revealing the processes of life.....

“Fortunately for the histologist the incessant experimentation of the last twenty-five years has brought to knowledge chemical substances which do for the tissues the wonder that was ascribed to the mythical Gorgon’s head—to kill instantly and to harden into changeless permanence all that gazed upon it. So the tissues may be fixed at any phase, and then studied at length. If then the investigator observes and keeps record of every point that may have an influence on the structural appearances, whether shown by experience or suggested by insight, and this record always accompanies the specimen, thus and thus only, it seems to me, can he feel confident that he is liable to gain real knowledge from the study, knowledge that represents actuality and which will serve as a basis for a newer and more complete unraveling of the intricacies of structure, an approximate

insight into the mechanism through which the life energy manifests itself.

"And so, with all the light that physics and chemistry can give, commencing with the simplest problems and being careful that every factor that can influence the result is being duly considered, the microscopist can go forward with enthusiasm and with hope, not with the hope that the great central question can be answered in one generation, perhaps not in a thousand, but confident that if each one adds his little to the *certain* knowledge of the world, then in the fullness of time the knowledge of living substance and the life processes will be so full and deep that what *life is*, though unanswered, may cease to be the supreme question."

After the address the professor was heartily congratulated on his excellent treatise.

#### THURSDAY MORNING.

The morning session was held in the anatomical lecture room of McGraw Hall at 9.30 o'clock and the following papers were read and discussed:

The chlorophyll bodies of *chara coronata*, by Prof. W. W. Rowlee, of Ithaca.

Secondary thickenings of the rootstalks of *spathyema*, by Mary A. Nichols, Ithaca.

A fourth study of the blood showing the relation of the colorless corpuscle to the strength of the constitution, by Dr. M. L. Holbrook, of New York City.

Two cases of intercellular spaces in vegetable embryos, by K. M. Wiegand, of Ithaca.

The fruits of the order *umbelliferae*, by Dr. E. J. Durand, of Ithaca.

The action of strong currents of electricity upon nervous tissue, by Dr. P. A. Fish, of Ithaca.

The morphology of the brain of the soft-shelled turtle and the English sparrow compared, by Susanna P. Gage, of Ithaca.

The flagella of motile bacteria, by Dr. V. A. Moore, of Washington, D. C.

The primitive source of food supply in the great lakes, by Prof. Henry B. Ward, Lincoln, Neb.

Some experiments in methods of Plankton measurements, Prof. Henry B. Ward, Lincoln, Neb.

#### THURSDAY AFTERNOON.

The afternoon was given up to recreation and the visiting microscopists and their friends were treated to an excursion on beautiful Cayuga Lake. The excursion party left the university campus at 1.15 and from the Renwick pier at 2 o'clock. Perhaps nothing added more to the pleasure of the visiting members than this trip. The beauty of the university campus and the surrounding scenery was a subject of admiration to all. The enjoyment was increased through the kindness of the two geologists, Professors Tarr and Williams of the University, who pointed out the geological features at various points along the lake.

#### FRIDAY MORNING.

The following papers were read and discussed during the morning session:

The fruits of the order compositæ, by Prof. W. W. Rowlee and K. M. Wiegand, Ithaca.

The spermatheca and methods of fertilization in some American newts and salamanders, by Dr. B. F. Kingsbury, Defiance, O.

Cocaine in the study of pond life, by Prof. H. S. Conser, Sunbury, Pa.

Paraffin and colodion embedding, by Prof. H. S. Conser, Sunbury, Pa.

Formalin as a hardening agent for nerve tissue, by Dr. Wm. C. Krauss, Buffalo.

The use of formalin in neurology, by Dr. P. A. Fish, Ithaca.

The lymphatics and the lymph circulation with demonstrations of specimens and apparatus, by Dr. Grant S. Hopkins, Ithaca.

New points in photo-micographs and cameras, by W. H. Walmsey, Chicago.

The question of correct naming and use of micro-reagents, by Miss V. A. Latham, M. D., Chicago.

A new way of marking objectives, by Dr. Wm. C. Krauss, Buffalo.

Demonstrations of histological preparations by the projection microscope, by Drs. Krauss and Mallonee, Buffalo.

Improvements in the collodion method, by Prof. S. H. Gage, Ithaca.

The Syracuse solid watch-glass for microscopical purposes, by Dr. A. Clifford Mercer, Syracuse, N. Y.

A metal centering block for mounting, by Magnus Pflaum, Pittsburg, Pa.

A new method of making wax-cells and of mounting in glycerine, by Magnus Pflaum, Pittsburg, Pa.

#### FRIDAY AFTERNOON.

The afternoon was taken up with the business meeting, which was held in McGraw Hall at 3 o'clock.

The Secretary of the society, Dr. Seaman, from an overwhelming amount of work and the death of a member of his family who had rendered him great assistance, felt compelled to resign the Secretaryship.

For the coming year the officers elected are: President, Dr. A. Clifford Mercer, F. R. M. S., of Syracuse, N. Y.; Vice-Presidents, Edward Pennock, of Philadelphia, Pa., and Miss V. A. Latham, M. D., D. D. S., of Chicago; Secretary, Dr. Wm. C. Krauss, of Buffalo, N. Y.; Executive Committee, Prof. C. H. Eigenmann, Bloomington, Ind.; Hermann Schrenk, St. Louis, Mo., and Miss M. A. Booth, Longmeadow, Mass.

A cordial invitation was sent from the Microscopical Club of Buffalo to hold the next annual meeting in Buffalo. The matter was left to the executive committee as usual. It is hoped, however, that an early decision will be reached, and then that the impulse for the prosperity of the society given this year will increase year by year till the society fills the place in our country which it so richly deserves to fill.

#### FRIDAY EVENING.

Friday evening a very pleasant soiree was held. About fifty microscopes were arranged in a hollow square in the university armory and gymnasium. If anyone felt discouraged before the meeting began it vanished as the meeting proceeded. The number of members present was about fifty, and some of those who could not be present sent papers. As this exhibition was especially designed to give people who have not had the opportunity of making extended study with the microscope the privilege of seeing for themselves some of the interesting and instructive revelations, most of the objects chosen for exhibition were those which would best serve to engage and please the average visitor's attention rather than those of the more particular scientific interest.

The exhibition lasted from 8 to 11 o'clock, and the wonders of the microscope seemed veritable miracles to some, who for the first time looked down the tube. The local managers are justified in feeling proud over the success of this soiree, which was indeed one of the features of the Ithaca meeting.

#### MANUFACTURERS' EXHIBITION.

The firms named below were represented at the meeting with the products of their manufacture as follows:

The Bausch & Lomb Optical Company of Rochester and New York, N. Y., with a full line of their micros-



scopes and microtomes of new construction. Also their photo-micrographic camera and various accessories.

E. Leitz, of Wetzlar, Germany, represented by Wm. Kraft, of New York, exhibited six grades of microscope stands; a mechanical stage; dissecting microscope with camera-lucida; Edinger's projection apparatus with photographic camera; photo-micrographic apparatus; microtomes of the Schanze and Thoma patterns.

Walmsley, Fuller & Co., of Chicago, exhibited Walmsley's new "Autograph" photo-micrographic camera, the improved handy camera, and Ross eclipse microscopes.

Joseph Zentmayer, of Philadelphia, Pa., exhibited his Columbia and Continental microscope stands and the Ryder microtome.

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### EDITORIAL.

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**The success** of the meeting just brought to a close at Ithaca, N. Y., of the American Microscopical Society is gratifying not only to the members of the Society but also to every student of things microscopical, bacteriological and biological. The papers presented were all of a high order and the evident care with which they had been prepared showed that in the opinion of the writers the occasion was one of the first importance. Apart from the scientific entertainment provided by the members of the A. M. S., the fine library and collections of botany, zoology and entomology owned by Cornell University, which were at the disposal of the visitors, afforded interest and enjoyment to all. The personnel of the newly elected board of officers is such as to give promise of renewed life and energy to the association and this, with an "onward and upward" determination on the part of one and all, should place the society among the foremost of the scientific associations of the world.

**Ye editor hereof**, after having taken a well-earned vacation of three months in Switzerland, will resume his functions with the next issue. Feeling the grave responsibility of the position we have occupied during his absence, we trust our subscribers will look with lenient eyes upon the shortcoming and faults no doubt apparent to them and console themselves with the reflection that the next issue will be "better than ever."

### NEW PUBLICATIONS.

*What are the Bacillariaceæ ?* by Dr. A. M. Edwards. M. J. Tempere predicts in his journal "Le Diatomiste" for June, 1895, that the proposition of Dr. Edwards to change the name Diatomaceæ to Bacillariaceæ (THE MICROSCOPE, April, 1895), will not be accepted, and that for two reasons:—a bad one, routine, that it is well established; a better one, that of the two etymologies, the first one is more logical and indicates something general in the Diatomaceæ, the other, which comes from bacillum (a small stick) contains but little of that idea, especially when discoidal or other forms are found.

*The Character of Agar-Agar, and the Bacillariaceæ Found in Connection with it,* by Dr. A. M. Edwards. In the same number of that periodical, M. J. Tempere gives a resume of an article published in "THE MICROSCOPE" for May 1895, and tells us that *Arachnoidiscus ornatus* is to be found in Agar-Agar but it is not *Arachnoidiscus ehrenbergii* as Doctor Edwards says.

*Chiero's Language of the Hand. A complete practical work on the sciences of chieromancy and cheirognomy, containing the system, rules and experience of Chiero the Palmist.* The Transatlantic Publishing Co., London and New York.

This is an exhaustive and admirably written treatise on the science of Palmistry. It not only contains a complete exposition of this branch of psychological study for the use of the student, but is a valuable work for every thoughtful investigator on the lines of natural physical science. As the author truly says:

The greatest truth may lie in smallest things,  
The greatest good in what we most despise,  
The greatest light may break from darkest skies,  
The greatest chord from e'en the weakest strings.

Forty full-page plates fully illustrate the subject treated, in addition to over 200 engravings of lines, mounts, marks, etc. Among the former are reproductions of the hands of a number of world-celebrated personages, which make an interesting comparative study, including those of Sarah Bernhardt, Mark Twain, "Bob" Ingersoll, Mrs. Annie Besant, Sir John Lubbock, and many others.

The book is the result of exhaustive study and research on

the part of the author in all parts of the world, and is probably the most elaborately written work on the subject yet published. It carries to the reader the intense earnestness and belief with which the author is evidently inspired.

*Systematic Study of the Organic Coloring Matters* by Drs. G. Schultz and P. Julius, translated and edited by A. G. Green, F. I. C., F. C. S. London: Macmillan & Co. \$5.00.

This is a valuable work primarily intended for the use of those interested in the coal-tar color industry and the users of its products. Here are set forth in detail all the various bodies: hydro-carbons, phenols, bases, etc., contained in coal-tar, together with the intermediate products and coloring matters. Under the latter heading will be found a series of admirably arranged tables containing all the information that can possibly be required for the use of the dyer. The commercial name of the product is set forth together with the scientific name, empirical formula, constitutional formula, method of preparation, year of discovery, discoverer, patents, literature, its behaviour with reagents, shade and dyeing properties and method of employment. To the user of coloring matters and to the chemist the work is of great value.

*Paul and Virginia*.—Bernardin de Saint-Pierre, translated with a biographical and critical introduction by Melville B. Anderson. A. L. McClurg & Co., 117-121 Wabash Avenue, Chicago, Ill. \$1.00.

In this story Saint Pierre uses the beauties of nature as seen in tropical seashore and cliffs as a background for a picture of the moral beauty of a little community. The portrayal of human nature and manners is no whit less faithful and vivid than the unrivalled picture of tropical landscape. The development of the two principal characters from childhood to manhood and womanhood is drawn with a fidelity that makes admiration increase with study. This book is worthy to be included among our classics. It has been translated many times but never with so much accuracy and such beauty of language as by Prof. M. B. Anderson of Stanford University. The book contains, besides the story, a fine biography of Saint Pierre and many critical notes, and is well adapted for use in schools. Prof. Anderson has also translated Hugo's "Shakespeare," "George Sand," "Madam de Sevigne," "Thiers," and others.

## LETTERS TO THE EDITOR.

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**Dear Doctor :** From the present outlook, the " Cotton States and International Exposition " will be one of the " events " in the history of our country, and especially of the south. Realizing the immense number of physicians who will be present, from all parts of the United States and other countries, I have decided to offer my mite of Southern hospitality to my visiting brethren. Therefore, I extend a cordial invitation to any physician who may visit our city, to make my office his headquarters. Send mail, telegrams, etc., in my care, and I will cheerfully engage rooms, etc., in advance for any one if advised to do so. The only request I make is to enclose postage for letters of inquiry, which will be cheerfully answered. For any services I may render no fee, commission, or any perquisites whatever, will be received or expected.

Fraternally yours,

GEORGE BROWN, M. D.

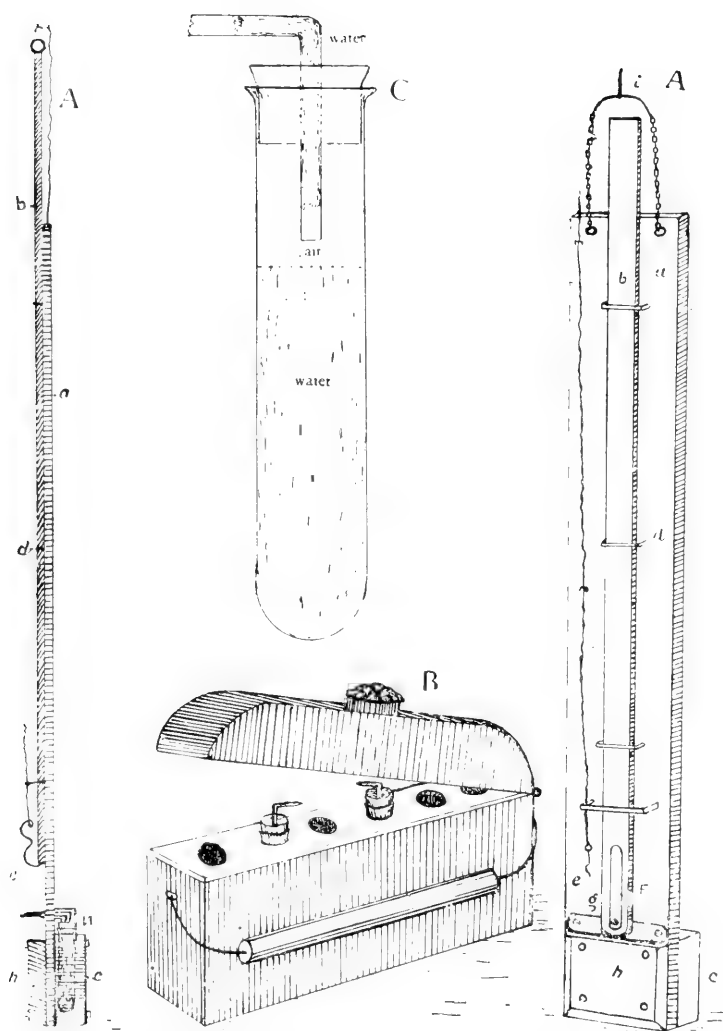
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## MICROSCOPICAL APPARATUS.

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**Watson & Sons' New Grand Model Van Heurck Microscope.**—For some years past we have had in our advertising columns a notice of the Van Heurck Microscope, manufactured by W. Watson & Sons of London. This, for a considerable time, has been their leading instrument for high-class work. They have now gone a step in advance and produced a similar stand of the same pattern, to which they have given the name of the "Grand Model Van Heurck Microscope." Like the original Van Huerck, it is built extremely solid, the limb being dovetailed right into the stage bracket so that these two important parts become as firm as if they were made up in one solid casting. Further, they have provided a complete rotation to the stage and the rectangular stage motions are both on the same center as in Messrs. Powell & Lealand's large stand. The instrument is considerably larger and more massive than its prototype, the original Van Heurck, the spread of the feet being 10 inches, and the height to the optical axis when the microscope is set horizontal is 10 inches—the normal vision reading distance. This last-named advantage obviates the necessity for packing the instrument up when using a camera-lucida, etc. Already several of these microscopes have found their way into this country and in our judgment it is a microscope that will satisfy the most exact requirements of the most critical workers. For schools and colleges there will be no duty to pay. Private individuals must pay the duty, which is not included in the prices asked by Messrs. Watson & Sons.





SPECIAL APPARATUS FOR BACTERIOLOGICAL SAMPLING OF  
WELL WATERS

THE AMERICAN  
MONTHLY  
MICROSCOPICAL JOURNAL.

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A Special Apparatus for Bacteriological Sampling of  
Well Waters.

WITH FRONTISPIECE.

BY H. L. BOLLEY AND MERTON FIELD,  
N. DAKOTA.

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Read before the Botanical Club of the A. A. A. S., at Springfield meeting,  
August 30, 1895.

To those engaged in bacteriological analysis of waters, proper sampling of the same commends itself as a necessity to the attainment of definite results. To be of use, this must be accomplished so as to take the desired amount from the point or depth in the body of water wished.

Different workers have used various methods and different types of apparatus. These sampling pieces have usually been vacuum tubes capable of being sealed by flame or else glass-stoppered bottles carefully sterilized. These do not seem satisfactory either as to rapidity of work allowed or for accuracy. For example, the small vacuum tubes of the Pasteur pattern are difficult to fill at any great depth of water under bacteriological conditions, and equally difficult to seal in the flame so as to prevent air contamination. Lepsius' self-filling, deep water sampling apparatus (see Sternberg's Manual, p. 555) is out of the question, as being entirely too cumbersome and because of the difficulty of sterilizing the mer-

cury, and especially so of sterilizing the whole apparatus previous to immersion in the water. Who, also, it may be asked, can fill and keep a glass-stoppered bottle sterile even were it possible to take the water samples at the desired depth, and replace the cork under bacteriological conditions?

It may thus not be inopportune to propose what is believed to be a more convenient and efficient method and apparatus. The latter consists of a self sinking standard, which may be sterilized in total, by steam, dry heat or by flaming, intended to allow the filling of a  $\frac{1}{2}$  to  $\frac{3}{4}$  vacuum in a sterile test tube at any desired depth of water. (The collecting vessel, including the method of sealing and the test tube, is essentially the form and method used by Russel in his work with deep waters. Otherwise the appliance is constructed as found most convenient for taking water from bored wells.)

Aside from the collecting vessel, it may be made of iron or other metal. A quickly constructed, simple type, and the one first used in this laboratory, from which the accompanying drawings were made, may be constructed of wood, but it becomes slightly more cumbersome and admits only of convenient flame sterilization for the exterior—unless one is possessed of a rather large sterilizing apparatus.

Metal construction: Make (a) a standard 18 in. x 1 in. x 2 in. (b) a striking bar 14 in. x  $\frac{1}{2}$  in. x  $1\frac{1}{4}$  in., to be worked by a trigger (e). The falling of this bar upon the sealed tube of the collecting vessel as it passes the rest upon which that tube lies, opens up the vacuum of the vessel to the inflow of water. The bar contains a slot at (f) which allows the unimpeded entrance of the water. The structure marked (c) is a box to hold the collecting vessel in proper position; at (d) is one of three wire guards holding the striking bar in position. The trigger and trip cord is shown at (e). At (g) is a metal



plate set into the wooden standard which is necessary for breaking the tube in the wooden machine. The plate marked (h) is that upon which the striking bar finally rests; at (i) is noted the attachment for lowering the appliance into the water. The rubber cork (j) is held in position by a swinging clamp.

In the wooden machine the standard is necessarily somewhat longer, say 2 ft. x 2 in. x 1 in. in measurement. In this appliance the striking bar (b) furnishes the sinking weight. It thus should be comparatively heavy. The measurements may be 25 in. x  $1\frac{1}{4}$  in. x  $\frac{1}{2}$  in.

In the accompanying plate of sketches, (c) represents a collecting vessel containing a proper amount of water when filled. The depth to which the water fills the vessel depends upon the completeness of the vacuum.

In filling, because of the sudden equilization of air pressure and the capillarity of the bore, there will always remain a certain amount of water in the tube. This is an important matter in the sampling, as, in connection with the air space in the vessel, the possibility of contamination of air and water after the sample is taken is overcome.

Sketch (B) represents a copper sterilization box for steam sterilizing the sealed tubes on the exterior. The box also serves as a transportation case allowing easy and safe carriage of several collecting vessels. Of course all the test tubes are thoroughly dry sterilized previous to the formation of the vacuum, the rubber corks and glass filling tubes being previously immersed in bichloride solution and alcohol bath. As cultures ought to be made very soon after the taking of the samples, the capillary water in the intake tube serves all the purposes of prevention from external contaminations. If, however, it is wished to keep the samples longer, the intake tube is available for flame-sealing as used in other methods.

The merits claimed for the method and appliance is the simplicity with which its different parts may be sterilized; ease of collection and transportation of numerous samples, and facilities afforded for avoiding after-contaminations.

Since the above was written, it has been found desirable that the apparatus should be even more compact of form than described under the metal construction. A number of these sampling pieces are now under construction in the Mechanical Department of the North Dakota Agricultural College, to be of brass finish and compact in form.

Agricultural Experiment Station for North Dakota, August 20, 1895.

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### The Processes of Life Revealed by the Microscope: A Plea for Physiological Histology.

By SIMON HENRY GAGE,

ITHACA, N. Y.

Presidential Address delivered before the American Microscopical Society,  
Wednesday Evening, Aug. 21, 1895.

It is characteristic of the races of men that almost at the dawn of reflection the first question that presses for solution is this one of life; life as manifested in men and in the animals and plants around them. What and whence is it and whither does it tend? Then the sky with its stars, the earth with its sunshine and storm, light and darkness, stand out like great mountain peaks demanding explanation. So in the life of every human being, repeating the history of its race, as the evolutionists are so fond of saying, the fundamental questions are first to obtrude themselves upon the growing intelligence. There is no waiting, no delay for trifling with the simpler problems; the most fundamental and most comprehensive come immediately to the fore and alone seem worthy of consideration. But as age ad-

vances most men learn to ignore the fundamental questions and to satisfy themselves with simpler and more secondary matters as if the great realities were all understood or non-existent. No doubt to many a parent engaged in the affairs of society, politics, finance, science or art, the questions that their children put, like drawing aside a thick curtain, bring into view the fundamental questions, the great realities; and we know again that what is absorbing the power and attention of our mature intellect, what perhaps in pride we feel a mastery over, are only secondary matters after all, and to the great questions of our own youth, repeated with such earnestness by our children, we must confess with humility that we still have no certain answers. It behooves us then, if the main questions of philosophy and science cannot be answered at once, to attempt a more modest task and by studying the individual factors of the problem to hope ultimately to put these together and thus gain some just comprehension of the entire problem.

This address is therefore to deal, not with life itself, but with some of the processes or phenomena which accompany its manifestations. But it is practically impossible to do fruitful work according to the Baconian guide of piling observation on observation. This is very liable to be a dead mass devoid of the breath of life. It is a well known fact that the author of the *Novum Organum*, the key which Bacon supposed would serve as the open-sesame of all difficulties and yield certain knowledge, this potent key did not unlock many of the mysteries of science for its inventor. Every truly scientific man since the world began has recognized the necessity of accurate observation, and no scientific principle has ever yet been discovered simply by speculation; but every one who has really unlocked any of the mysteries of nature has inspired, made alive his observations by the imagi-

nation; he has, as Tyndall so well put it, made a scientific use of the imagination and created for himself what is known as the 'working hypothesis.' It must be confessed that for some investigators the 'hypothesis' becomes so dear that if the facts of nature do not conform to the hypothesis, 'so much the worse for the facts.' But for the truly scientific man, the hypothesis is destined solely to enable him to get facts of nature in some definite order, an order which shall make apparent their connection with the great order and harmony which is believed to be present in the universe.

If the working hypothesis fails in any essential particular he is ready to modify or discard it. For the truly inspired investigator, one undoubted fact weighs more in balance than a thousand theories.

At the very threshold of any working hypothesis for the biologist, the question as to the nature of the energy we call life must be considered. The great problem must receive some kind of a hypothetical solution. What is its relation to the energies of light, electricity, chemism and the other forms discussed by the physicist? Are its complex manifestations due only to these or does it have a character and individuality of its own? If we accept the ordinarily received view of the evolution of our solar system, the original fiery nebula in which heat reigned supreme slowly dissipated part of its heat, and hurled into space the planets, themselves flaming vapors, only the protons of the solid planets. As the heat became further dissipated there appeared in the cooling mass manifestations of chemical attraction, compounds at first gases, then liquids, and finally, on the cooling planets, solids appeared. Lastly, upon our own planet, the earth, when the solid crust was formed and the temperature had fallen below the boiling point of water, the seas were formed and then life appeared. Who could see, in the incandescent nebula, the liquids and solids of

our planet and the play upon them of chemism, of light, heat, electricity, cohesion, tension and the other manifestations so familiar to all ? And yet, who is there that for a moment believes that aught of matter or energy was created in the different stages of the evolution ? They appeared or were manifested just as soon as the conditions made it possible. So it seems to me that the energy called Life manifested itself upon this planet when the conditions made it possible, and it will cease to manifest itself just as soon as the conditions become sufficiently unfavorable. It was the last of the forms of energy to appear upon this planet, and it will be the first to disappear.

In brief, it seems to me that the present state of physical and physiological knowledge warrants the assumption, the working hypothesis, that life is a form of energy different from those considered in the domain of physics and chemistry. This form of energy is the last to appear upon our planet, last because more conditions were necessary for its manifestations. It, like the other forms of energy, requires a material vehicle through which to act, but the results produced by it are vastly more complex. Like the other energies of nature it does not act alone. It acts with the energies of the physicist, but as the master; and under its influence the manifestations pass infinitely beyond the point where for the ordinary energies of nature it is written 'thus far and no farther.'

It can be stated without fear of refutation that every physiological investigation shows with accumulating emphasis that the manifestations of living matter are not explicable with only the forces of dead matter, and the more profound the knowledge of the investigator the more certain is the testimony that the life energy is not a mere name. And, strange to say, the physicist

and chemist are most emphatic in declaring that life is an energy outside their domain.

The statements of a chemist, a physicist and a biologist are added. From the character and attainments of these men, their testimony, given after years of the most earnest investigation and reflection, is worthy of consideration.

When Liebig was asked if he believed that a leaf or a flower could be formed or could grow by chemical forces, he answered: "I would more readily believe that a book on chemistry or on botany could grow out of dead matter by chemical processes."

"The influence of animal or vegetable life on matter is infinitely beyond the range of any scientific inquiry hitherto entered on. Its power of directing the motions of moving particles, in the demonstrated daily miracle of our human free will, and in the growth of generation after generation of plants from a single seed, are infinitely different from any possible result of the fortuitous concourse of atoms; and the fortuitous concourse of atoms is the sole foundation in philosophy on which can be founded the doctrine that it is impossible to derive mechanical effect from heat otherwise than by taking heat from a body at a higher temperature, converting at most a definite proportion of it into mechanical effect and giving out the whole residue to matter at a lower temperature."—Sir William Thomson (Lord Kelvin).

"The anagenetic (vital) energy transforms the face of nature by its power of assimilating and recombining inorganic matter, and by its capacity for multiplying its individuals. In spite of the mechanical destructibility of its physical basis (protoplasm) and the ease with which its mechanisms are destroyed, it successfully resists, controls and remodels the catagenetic (physical and chemical) energies for its purpose."—Cope.

What then are the manifestations of the life energy? And what are the processes which are discernible? All of us in whatever walk of life will recognize the saying of Gould: "Now when one looks about him, the plainest, largest fact he sees is that of the distinction between living and lifeless things."

As life goes on and works with power where the unaided eye fails to detect it, the microscope—marvelous product of the life energy in the brain of man—shows some of these hidden processes. It has done for the infinitely little on the earth what the telescope has done for the infinitely great in the sky.

Let us commence with the little and the simple. If a drop of water from an aquarium, stream or pool is put under the microscope many things appear. It is a little world that one looks into, and like the greater one that meets our eye on the streets, some things seem alive and some lifeless. As we look we shall probably find, as in the great world that the most showy is liable in the end to be the least interesting. In the microscopic world there will probably appear one or more small rounded masses which are almost colorless. If one of these is watched, lo, it moves, not by walking or swimming, but by streaming itself in the direction. First a slender or blunt knob appears, then into it all of the rest of the mass moves, and thus it has changed its position. If the observation is continued, this living speck, which is called an *amœba*, will be seen to approach some object and retreat; indeed, it comports itself, as if sensitive, with likes and dislikes. If any object suitable for food is met in its wanderings the living substance flows around it, engulfs it and dissolves the nutrient portions and turns them into its own living substance; the lifeless has been rendered alive. If the eye follows the speck of living matter, the marvels do not cease. After it has grown to a certain size, as if by an invisible string, it constricts it-

self in the middle and finally cuts itself in two. The original amœba is no more; in its place there are two. Thus nearly at the bottom of the scale of life are manifested all of the fundamental features, the living substance moves itself, takes nourishment, digests it and changes non-living into living substance and increases in size; it seems to feel and to avoid the disagreeable and choose the agreeable and finally it performs the miracle of reproducing its kind, of giving out its life and substance to form other beings, its offspring.

It is the belief of many biologists that the larger and complex forms even up to man himself may be considered an aggregation of structural elements originally more or less like the amœba just described; but instead of each member of the colony, each individual itself carrying on all the processes of life independently, as with the amœba, there is a division of labor. Some move, some digest, some feel, think and choose, some give rise to new beings, all change lifeless matter into their own living substance.

The processes and phenomena by which a new individual is produced are included under the comprehensive term, Embryology.

All organisms, great or small, are but developments of minute germs budded off by the parent or parents, and the way in which these minute beginnings develop into perfect forms like their parents can only be followed by the aid of a microscope. Indeed, in no field of biology has the microscope done such signal service in revealing the processes of life.

The method of the production of a new being with the amœba, as we have just seen, is for the parent to give itself entire to its offspring—the parent ceasing to be in producing its offspring. With some other lowly forms a part of the body of the parent buds out, grows and finally falls off as an independent organism, or remains



connected with the parent to form a colony. In the plant world a familiar example of a colony is represented by the cactus that the children call 'Old Hen and Chickens.'

In the higher animals, however, where specialization has been carried to its extreme limit, some myriads of cells forming the body are set apart to produce motion, others digest food, still others think and feel, while comparatively few, the *germ cells* are destined for the continuation of the race. In the higher and highest forms especially, all observation goes to show that the life energy, not satisfied with the mere vitalization of matter and a dead level of excellence, is aiming at perpetual ascent, greater mastery over matter and its physical forces. For the more certain attainment of this end, the production of offspring is no longer possible for one individual; two wholly separate individuals must join, each contributing its share of the living matter which is to develop into a new being. In this way the accumulated acquirements of two are united with the consequent increase in the tendencies and impulses for modification, and nearly double the protection for the offspring. Thus in striking contrast with the amoeba, where the single parent gives all of itself to form offspring, and in so doing disappears and loses its individuality, the higher forms, while two must unite to form the offspring, the parents remain and retain their individuality and the ability to produce still other offspring. The process by which this is accomplished may be traced step by step with the microscope. A germ cell of the father and one of the mother fuse together, and from this new procreative cell, formed by the fusion of two with all their possibilities combined, the new individual arises. This certain knowledge is the result of the profound investigation of the last few years and shows the literalness of the scriptural statement, 'they shall be one flesh.'

After this fusion of the father and mother germ cells,

the single cell thus formed, like the amoeba, divides into two, and these into four and so on, but unlike the amoeba all the cells remain together. Within this cellular mass, as if by an unseen builder, the cells are deftly arranged in their place, some to form brain, some heart, some the digestive tract, others for movement, so that finally from the simple mass of cells, originally so alike, arises the complex organism, fish or bird, beast or man. How perfectly the word *offspring* describes the life process in the production of this new being! That the child should resemble both father and mother is thus made intelligible, for it is a part of both. Yes, further, it may resemble grandfather or great grandfather or mother, for truly it is a part of them, their life conserved and continued. There is no new life, it is only a continuation of the old: '*Omne vivum ex vivo*,' all life from life. But the demonstration of this prime fact required a microscope, and it is an achievement of the last half of this century. How counter this statement still is to the common belief of mankind we may perhaps better appreciate if we recall our own youth, and remember with what absolute confidence we expected the stray horse-hairs we had collected and placed in water to turn into living snakes. The belief that it is an every-day occurrence for living beings to arise from lifeless matter was not by any means confined to those uneducated in biology. It was held by many scientific men within the memory of most of us. Indeed, this goblin of *Spontaneous generation*, even for the scientific world, has been laid low so recently that the smoke of battle has scarcely yet cleared from the horizon.

In the complex body of animals, as stated above, the constituent elements perform different functions. Is there any hint of the way in which the action is accomplished? Let us glance at two systems, the nervous and the glandular, widely different in structure and function.

All know how constantly the glands are called into requisition, the salivary glands for saliva, those of the stomach and pancreas for their digestive juices, etc. If we take now the pancreas as an example, and that of a living fasting animal is put under the microscope so that its constituent cells can be observed, it will be seen that they are clouded, their outlines and that of their nuclei being very vague and indistinct. The cell is apparently full of coarse grains. If now the animal is fed, as the digestion proceeds the pancreas pours out its juice. At the same time the granules and with them the cloudiness gradually disappear, the cells become clear and both they and their nuclei are sharply outlined. That is, the substance which is to form the pancreatic juice is stored in the cells in the form of granules during the periods of rest and held until the digestive agent is demanded, and if the demand is great all the granules may be used up. But as soon as the demand ceases the cells begin again their special vital action, and again the granules begin to appear and increase in number until finally the cells become so full that they are fully charged and again ready to pour forth the digestive fluid. This is a daily, almost an hourly process. Let us take another examination in which there would almost appear an organic memory on the part of the gland cells. No doubt all have seen the clear jelly-like masses surrounding the eggs of frogs and salamanders. Whence comes this jelly that is so resistant to the agents that work so quickly the destruction of ordinary organic matter? As spring advances the cells of the oviduct increase enormously in size. The microscope shows this increase to be due to a multitude of clear granules. As the eggs move along, the ova are coated with the jelly formed from the granules given out by the cells. As this material for the jelly is poured out the cells gradually

shrink to their original size, and then wait another twelve months before doing their destined work.

If one can thus catch a glimpse of some of the finer processes taking place in gland action, how is it with nervous action, the highest function of which living matter is capable? While it has been known for a long time that the nervous system is the organ of thought and feeling and the director and co-ordinator of the motions of the body, and many speculations have been made concerning the processes through which the nervous tissue passes in performing its functions, it was left to an American student, Dr. Hodge, to first successfully show that there were visible changes through which the nervous system passes in its work. The question is, can the activity of the nervous system be traced as surely by changes occurring in the living matter forming its basis as the action of a gland can be seen by the study of the gland cells?

The demonstration is simple now that the method has been shown. No doubt every one has had the experience of failing to perform some difficult muscular action at one time and then at another of doing it with ease, or of finding true the reverse of the adage 'practice makes perfect.' For example, in a trial of skill, as in learning to ride a bicycle, all the complicated action may be performed with considerable ease and certainty when one is fresh, but as the practice continues the results become progressively less and less successful till finally with increasing weariness there is only failure and one must rest. We say the muscles are tired; this is true in part, but of much greater importance is the fatigue of the nervous system, as this furnishes the impulses for the action and co-ordination of the muscles. Now, as muscular action can be seen and the amount can be carefully controlled, here was an exact indicator of the time

and amount of the nervous activity. Furthermore, as animals have two similar sides, one arm or leg may work and the other remain at rest, and consequently corresponding sides of the nervous system may be active and at rest. By means of electrical irritation one arm of a cat or other animal was caused to move vigorously for a considerable time, the other arm remaining at rest. Then the two sides of the nervous system, that is the pairs of nerves to the arms with their ganglia and a segment of the myel (spinal cord), were removed and treated with fixing agents, and carried through all the processes necessary to get thin sections capable of accurate study with the microscope. Finally, upon the same glass slide are parts of the nervous system fatigued even to exhaustion, and corresponding parts of the same animal which has been at rest. Certainly if the nervous substance shows the result or processes of its action the conditions are here perfect. Fatigued nerve cells are side by side with those in a state of rest. The appearances are clear and unmistakeable; the nucleus has markedly decreased in size in the fatigued cells and possesses a jagged irregular outline in place of the smooth rounded form of the resting cells. The cell substance is shrunken in size and possesses clear scattered spaces or a large clear space around the nucleus.

If the nervous substance was not fixed at once, but remained in the living animal for twelve to twenty-four hours in a state of repose, the signs of exhaustion disappeared and the two sides appeared alike. By studying preparations made after various periods of repose all the stages of recovery from exhaustion could be followed.

For possible change, in normal fatigue, sparrows, pigeons and swallows and also honey bees were used. For example if two sparrows or two honey bees as nearly alike as possible were selected, the nervous system of one

being fixed in the morning after the night's rest and that of the other after a day of toil, the changes in the cells of the brain of the honey bee or sparrow and in the spinal ganglia of the sparrow were as marked as in case of artificial fatigue. After prolonged rest then the nerve cells are *charged*, so to speak—they are full and ready for labor, but after a hard day's work they are *discharged*, shrunken and exhausted.

There is one more step in this brilliant investigation. If in the morning after sleep and rest animals and men are full of vigor, and in the evening are weary and exhausted, how like it is to the beginning and end of life? In youth, so overflowing with vigor that to move, to act, is a pleasure and continued rest a pain. But in the evening of life a warm corner and repose are what we try to furnish those whose work is done. How is this correlated in the cells of the nervous system with the states of rest and fatigue? With a well-nourished child which died from one of the accidents of birth the nerve cells showed all the characters of cells at rest and fully charged. In a man dying naturally of old age the cells showed the shrunken nuclei and all the appearances of exhausting fatigue. In the one was the potentiality of a life of vigorous action; the other showed the final fatigue—the store of life-energy had been dissipated and there was no recovery possible.

For the animals that possess an undoubted nervous system probably all would admit that there is some sort of nervous action corresponding to sensation; but what of living matter in the humbler forms where no nervous system can be found? That these have vital motion, that they breathe, nourish themselves, grow and produce offspring, none can deny. Do they have anything comparable with sensation? As most of the lower forms are minute, the microscope comes to our aid again, and

in watching these lowliest living beings it is found that they discriminate and choose, going freely into some portions of their liquid world and withdrawing from other portions. If some drug which is unusual, or we must believe disagreeable, is added to a part of the water they withdraw from that part. It seems to have the same effect as disagreeable odors on men and animals. On the other hand, there are substances which attract, and into the water containing these they enter with eagerness. Strange is it too that as proved by experiment, if an unattractive substance is used, and also one on the other side that has been still more attractive, the less disagreeable is selected, the less of two evils is chosen.

As man, the horse, dog and many other animals adapt themselves gradually to temperatures either very cold or very warm, and that too by a change in their heat-regulating power rather than by a change of hairy or other clothing, so these lowly organisms are found in nature in water at temperatures from near freezing up to 60°—80° C.; a point approaching that of boiling water. It may be answered that each was created for its place; but by means of a microscope and a delicate thermostat, to be certain of every step and to see all the results, Dr. Dallinger, through a period of seven years, accustomed the same unicellular organism and its progeny to variations of temperature from 15°—20° C.; *i. e.*, about the temperature of a comfortable sitting-room, up to 70°C. For those at the cooler temperature it was death to increase rapidly the temperature 10° and for those at the higher temperature it was equally fatal to lower the heat 15°—20°, their original normal temperature. These examples seem to show that it is one of the fundamental characteristics of living substances, whether in complex or simple forms, to adapt themselves to their environment.

There is another fact that the microscope has revealed

and that fills the contemplative mind with wonder and an aspiration to see a little farther into the living substance, and so perchance discover the hidden springs of action. This fact may be called *cellular altruism*. In human society the philanthropist and soldier are ready at any time to sacrifice themselves for the race or the nation. With the animals the guards of the flock or herd are equally ready to die in its defence.

So within each of the higher organisms the microscope has shown a guarding host, the leucocytes or white corpuscles. The brilliant discoveries in the processes of life with higher forms have shown that not only is there a struggle for existence with nature and against forms as large or larger than themselves, but each organism is liable to be undermined by forms, animal and vegetable, infinitely smaller than themselves, insignificant and insidious but deadly. Now to guard the body against these living particles of dust that would tend to clog the system there is a vast army of amœba-like cells, the leucocytes, that go wherever the body is attacked and do battle. If the guards succeed the organism lives and flourishes, otherwise it dies or becomes weakened and hampered. This much was common scientific property three years ago, when one of our members (Miss Edith J. Claypole) came to my laboratory for advanced work. I discussed with her what has just been given, and told her that there still remained to be solved the problem what becomes of the clogging or deleterious material which the leucocyte take up? These body guards are after all a part of the organism, and for them simply to engulf the material would not rid the body entirely of it, and finally an inevitable clogging of the system would result.

The problem is simple and definite: What becomes of the deleterious substances, bacteria and dust particles, that get into the body and become engulfed by the leucocytes? Fortunately for the solution of this problem,



in our beautiful Cayuga Lake there is an animal, the *Necturus*, with external gills through which the blood circulates for its purification. So thin and transparent is the covering tissue in these gills that one can see into the blood stream almost as easily as if it were uncovered. Every solid constituent of the blood, whether red corpuscle, white corpuscle, microbe or particle of dust, can be seen almost as clearly as if mounted on a microscopic slide.

Into the veins of this animal was injected some lamp-black mixed with water, a little gum arabic and ordinary salt, an entirely non-poisonous mixture. Thousands of particles of carbon were thus introduced into the blood and could be seen circulating with it through the transparent gills. True to their duty, the white corpuscles in a day or two engulfed the carbon particles, but for several days more the leucocytes could be seen circulating with the blood stream and carrying their load of coal with them. Gradually the carbon-laden corpuscles disappeared and only the ordinary carbon-free ones remained. Where had the carbon been left? Had it been simply deposited somewhere in the system? The tissues were fixed and serial sections made. The natural pigment was bleached with hydrogen dioxid, so that if any carbon was present it would show unmistakably. With the exception of the spleen, no carbon appeared in the tissues, but in many places the carbon-laden leucocytes were found. In mucous surfaces and on the surface of the skin were many of them; in the walls of organs were many more apparently on their way to the surface with the load, that is the carbon is actually carried out of the tissues upon the free surfaces of the skin and mucous membranes, where, being outside of the body, it could no more interfere in any way with it. But what was the fate of the leucocytes that carried the lampblack out of the tissues? They carry their load

out and free the body, but they themselves perish. They sacrifice themselves for the rest of the body as surely as ever did soldier or philanthropist for the betterment or preservation of the state.

Thus I have tried to sketch in briefest outline some of the phenomena or processes of life revealed by the microscope. Most of those discussed have come under my own personal observation and are therefore to me particularly real and instructive. But to every one long familiar with the microscope and with the literature of biology, many other examples will occur, some of them even more striking. This discussion has been confined to the above also because it seems to me to show with great clearness the way in which we can justifiably hope to do fruitful work in the future. This sure way it seems to me is the study of structure and function together; the function or activity serving as a clew and stimulus to the investigator for finding the mechanism through which function is manifested and thus give due significance to structural details which, without the hint from the function, might pass unnoticed.

This kind of microscopical study, it seems to me, may be well designated as Physiological Histology. It is in sharp contrast with ordinary histology, in which too often the investigator knows nothing of the age, state of digestion or of fasting, nervous activity, rest or exhaustion. Indeed, in many cases it is a source of congratulation if he knows even the name of the animal from which the tissue is derived. Such haphazard observation has not in the past, and is not likely in the future, to lead to splendid results. If structure, as I most firmly believe, is the material expression of function, and the sole purpose of the structure is to form the vehicle of some physiological action, then the structure can be truly understood only when studied in action or fixed and studied in the various phases of action.

Indeed, if one looks only for form or morphology in the study of histology, the very pith and marrow is more than likely to be lost.\*

For example, if one wished to study the comparative histology of the pancreas and were to take pieces from various animals to be compared without regard to their condition of fasting or digestion, he might find the coarser anatomical peculiarities in each. In all probability he would also find two distinct structural types, with various gradations. One type with clearly defined cells and nuclei, the other with the cells clouded, filled with granules and with the outlines of cells and their nuclei almost indiscernable. Between these there might be various gradations in the different forms. And yet, from what has been stated above, it is plain that all these different structural appearances represent phases of activity, and all might have come from the selfsame animal. In like manner, if certain parts of the nervous system were to be studied comparatively, and the tissue taken from one animal after refreshing sleep and rest, from another after exhausting labor, another in infancy, and another from an animal decrepit in years, the difference in general appearance and in structural details would be striking enough to satisfy any morphologist that, as with the structure of the pancreatic cells, there were two or more distinct types; but the physiological histologist

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\*Although in a different field, the words of Osborn in discussing the unknown factors of evolution are so pertinent that they may well be quoted: "My last word is that we are entering the threshold of the evolution problem, instead of standing within the portals. The hardest tasks lie before us, not behind us." "We are far from finally testing or dismissing these old factors [of evolution], but the reaction from speculation upon them is in itself a silent admission that we must reach out for some unknown quantity. If such does exist there is little hope that we shall discover it except by the most laborious research; and while we may predict that conclusive evidence of its existence will be found in morphology, it is safe to add that the fortunate discoverer will be a physiologist, 'armed with a microscope,' I would like to add."—*Am. Nat.*, May, 1895.

would recognize at once that the differences so much insisted upon represented different phases of activity, and, as with the pancreatic cells, might be all represented in the same animal at different times.

It would be far from saying that there are no structural differences in the different animals independent of any particular phase of functional activity; but if these only are sought and the others neglected, the physiological appearances will often obtrude and confuse, if they do not utterly confound.

I have therefore for the last ten years urged my students and mean to go on advocating with all the earnestness of which I am capable, that, in studying an organism or its tissues, the investigator, to gain certain knowledge, must know all that it is possible to learn concerning the age, health, state of nervous, muscular and digestive activity; in fact, all that is possible to find out about the processes of life that are going on when the study is made.

Fortunately, there are some microscopic forms in which the entire study can be made while the creature is alive. With the higher organisms also some of the living elements, as the white corpuscles, can be studied and their various actions and structural changes observed for a considerable time. Most of the tissues of the higher forms, however, cannot be thus studied, and the best that can be done is to fix the different phases of action, as by a series of instantaneous photographs, then with a kind of mental kinetoscope put these together and try to comprehend the whole cycle.

Fortunately for the histologist, the incessant experimentation of the last twenty-five years has brought to knowledge chemical substances which do for the tissues the wonder that was ascribed to the mythical Gorgon's head—to kill instantly and to harden into changeless permanence all that gazed upon it. So the tissues may

be fixed at any phase, and then studied at length. If then the investigator observes and keeps record of every point that may have an influence on the structural appearances, whether shown by experience or suggested by insight, and this record always accompanies the specimen, thus and thus only, it seems to me, can he feel confident that he is liable to gain real knowledge from the study, knowledge that represents actuality and which will serve as the basis for a newer and more complete unraveling of the intricacies of structure, an approximate insight into the mechanism through which the life energy manifests itself.

And so, with all the light that physics and chemistry can give, commencing with the simplest problems and being careful that every factor that can influence the result is being duly considered, the microscopist can go forward with enthusiasm and with hope, not with the hope that the great central question can be answered in one generation, perhaps not in a thousand, but confident that if each one adds his little to the *certain* knowledge of the world, then in the fullness of time the knowledge of living substance and the life processes will be so full and deep that what *life is*, though unanswered, may cease to be the supreme question.

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**Telephone Germ Diseases.**—The medical journals of Paris are considerably agitated over the possibility of the communication of microbic diseases by means of the telephone. This is a subject which doubtless ought to receive more attention than has hitherto been accorded to it. Many persons, in using the telephone, allow the ears or lips to touch the ear-piece or mouth-piece of the instrument, and, by so doing, may contaminate it if suffering from disease, or they may become contaminated if the instrument has been in contact with a diseased person. Some means ought certainly to be provided by which this source of danger may be avoided.

## Nucleus of Red Blood-Corpuscle of Mammals.

BY JOHN MICHELS,

NEW YORK.

I have read Dr. William Moser's remarks, in the Medical Record of October 20th last, relating to the caryocinetic changes in the red corpuscle, with much interest, as I there recognized various appearances of blood which I discovered during examination under the microscope about seven years ago, which interested me greatly at the time.

Up to this date it appears to be a recognized fact, taught in all text-books, that a nucleus did not exist in the red corpuscle of mammals, except in the embryo, and as a consequence, in certain anæmic conditions of the blood. I was always unwilling to accept that conclusion, on account of the admitted importance of all nuclei to cell life, and thus as the blood corpuscles of birds and reptiles always contained a nucleus at all stages of their existence, it seemed highly probable that they really existed in the red mammalia, and, reasoning by analogy, it seemed difficult to account for their absence, especially as they had been seen in human blood in the foetal stage and under certain pathological conditions.

As I considered that the nucleus was composed of protoplasm, it struck me that the stain used by botanists as a reagent for this material in plants would be the best to employ to demonstrate the nucleus of the red corpuscle of animals, if it contained protoplasm.

Acting on this suggestion, I made a large number of human blood preparations in the following manner: Placing a drop of human blood on a slide, 3x1 inches, I then took another slide and drew the sharp edge rapidly across it at right angles, using all the pressure possible and allowing it to dry. This is the best method of ob-

taining a single layer of blood with the corpuscles evenly distributed. When quite dry I pour over the preparation a strong solution of iodine, and remove after about a minute. It will dry rapidly, and then be ready for microscopical examination.

I may here state that preparations of blood treated in this manner will remain in good form for an almost indefinite length of time, needing no glass cover or any preservative, and can be examined dry.

This examination of preparations of blood, dry, and without the addition of a glass cover, I consider an important feature of my work, and accounts for my seeing so much which had escaped previous observation, because I noticed that the addition of Canada balsam and other preservatives and a cover, caused most of the special features to disappear.

I was surprised to find on making a microscopical examination of human blood thus prepared, that all the red corpuscles in the field showed in each instance a clearly defined nucleus, some in the centre of the cell, and at the edge in others; in many instances two nuclei were visible in the one cell, and in rare instances they were in a cluster of five or six. In some instances were exhibited what a German authority calls homogeneous cells, having merely a very fine line as an outer ring, and in some cases such cells contained a nucleus.

At the time I made a very fine photograph of this slide showing all these appearances above described in the most clear and definite manner, but I failed to find any specialist who would take the slightest interest in the subject. I was aware that Dr. Osler, late of Canada, and then holding a professorship at the Johns Hopkins University, had given much attention to the microscopical appearance of blood, and I forwarded to him copies of my original photograph and enlarged copies of the same; but he came to the conclusion that because they

had failed in their laboratory to find a nucleus in the red corpuscle by any of their methods of staining, that a nucleus did not exist, although he admitted that I had stained and photographed such an object which was optically perfect. I have still the original plate of my photograph, and have shown copies to hundreds of physicians.

However, feeling discouraged at the want of sympathy with my work, I simply let the matter drop, and was glad to find by Dr. Moser's paper that the subject is now claiming attention and has a prospect of being followed up, as I consider it will be an important factor in solving many of the most difficult medical problems of the present day, when systematic and intelligent microscopical examination of the blood is carried on.—*Medical Review.*

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### The Microscope in Diagnosis and Prognosis.

By C. H. EVANS, M. D.  
CANTON, OHIO.

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[Extract from a paper read before the Union Medical Association of North Eastern Ohio.]

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In the investigation of disease for definite diagnosis and prognosis the tendency of the day is to rely more and more on the microscope and microscopical methods of observation and investigation. In fact, the microscope has been the principal means by which medicine has advanced from an art to its present position as a science, and the microscope has now become so essential in medical practice that it is almost indispensable in the every-day work of the conscientious physician, and to-day I desire to emphasize the importance of a more extended use of the microscope in general practice, as it is often the only means at our disposal in many doubtful



and obscure cases whereby we can establish a positive diagnosis and prognosis. By the combined use of the microscope, advanced chemistry and bacteriology, the art of medicine of the past with its conjectures and guesses, has risen to the more exact scientific basis of the present, with its positive microscopical demonstrations in diagnosis and prognosis. The improvement in the microscope by opticians of late years, combined with the discovery of the aniline dyes, have made it possible for us to acquire a knowledge of the micro-organisms and through its power to discover the microbic origin of many of the infectious and contagious diseases. The essential cause, without which the disease could not exist, has been discovered, classified and tabulated to the number of over 70 distinct species of microbes, with many of their specific diseases ("Eisenberg's Bacteriological Diagnosis") a vast work far in advance of anything previously attained in medicine as an art, and far beyond our most sanguine expectation in medicine even as a science—an accomplishment possible only by patient microscopical investigation and close bacteriological study. As the essential causes of many of the infectious and contagious diseases have been discovered, without which the disease cannot exist, no matter what may be the predisposing factors, therefore a knowledge of each particular essential cause enables a competent observer in many obscure cases of disease to make a positive diagnosis and prognosis by microscopical examination of sputa, blood, urine, feces, exudate, discharge or whatever nidus contains the specific germ of the disease. We affirm that the micro-organisms do not change their types, no matter what may be their environments; they retain their individuality of species, they do not change from one species into another; for in the living human body we only find the gonococcus in gonorrheal pus, bacillus tuberculosis in tubercle, the comma ba-

cillus in Asiatic cholera, bacillus anthracis in malignant pustule or wool-sorter's disease, bacillus pneumoniae of Friedlaender in pneumonia, the plasmodium malariae in malarial fever, the spirillum of Obermier in relapsing fever, the bacillus of Eberth in typhoid fever, the Klebs Loeffler bacillus in diphtheria, the bacillus mallei in glanders, the bacillus of Nicobaer in the secretions of wounds of those suffering with tetanus, and what shall I say more, for the time would fail me to go into an extended consideration of this important subject. So with this introduction I will ask your attention to a few examples of the practical application of the microscope in diagnosis and prognosis.

#### EXAMINATION OF SPUTA.

Dried cover glass stained preparations must be made. Since Robert Koch's discovery of the bacillus tuberculosis in 1884, their presence in the sputa has been considered by all observers to be of great diagnostic value, and indeed when found in quantity are positive evidence of tubercular disease somewhere in the respiratory tract or in the lungs, and yet, they may be found in the sputa and the case not be a hopeless one; one swallow does not make a summer, yet it might indicate its near approach, neither does the finding of one bacillus in the sputa of a suspected case prove it to be one of tuberculosis. Again, if the bacilli are found in the phagocytes only, and not free, and there is no indication of destruction of tissues present in the sputa under examination, a favorable diagnosis and prognosis can be made, for it is evident the system is taking care of itself to a great extent and with good hygienic conditions and proper treatment the patient will in all probability recover.

But if the bacilli are found free and contain spores and associated with spores indicating the vigorous

growth and rapid multiplication of the bacilli; or when associated with elastic fibers or areoli, indicating destruction or breaking down of lung tissue, then a positive diagnosis of pulmonary phthisis and unfavorable prognosis should be made.

The presence of the bacillus pneumoniae of Friedlaender in the sputa, if in quantity, is positive evidence of pneumonia and when associated with dead pus in quantity is evidence of pneumonic abscess and with copious expectoration indicates the abscess is being discharged through the bronchi with probable recovery. But if the bacilli of tuberculosis are also present, it changes the diagnosis to pulmonary phthisis with multiple abscess of the lung, a hopeless case with rapid fatal termination.

The presence of pus, if in quantity, in the sputa and especially if dead pus, is evidence of an abscess somewhere in the respiratory tract or in the lungs and when broken down tissue is also present the character of the debris will locate the abscess and so we may by microscopical examination of the sputa, noting the presence or absence of certain well-known micro-organisms and the presence or absence of the various pathological products, not only make a positive diagnosis and prognosis but often in unfavorable cases tell how long the patient will live with no other data upon which to base an opinion.

#### EXAMINATION OF URINE.

For the detection of bacillus tuberculosis in the urine, dry cover glass preparations must be made and stained in the usual way. Also for the detection of the gonococci in the urine. Dead pus can only be recognized after staining in dry cover glass preparations.

*Tube casts.*—Since the days of John Bright, of England, the presence of tube casts in the urine have been

regarded as an evidence of a serious malady. The advance in medical microscopy in the later years have taught us to consider the quality of the casts of far more importance than the quantity.

*Mucine casts*, with small amounts of albumen in the urine, the formative elements absent, indicate simply catarrh of the kidneys, while the same casts with formative elements present and imbedded in their matrix, indicating their acquisition to the casts during their formation in the uriniferous tubules, changes the diagnosis to catarrhal nephritis, with favorable prognosis under treatment.

*Hyaline casts*, with formative elements absent, indicate a more advanced state of disease than mucine casts under same conditions of association, yet favorable prognosis. Hyaline casts with albumen pus and renal epithelium embedded in the casts, indicate clearly a case of tubal nephritis.

*Fatty casts*, with columnar epithelium and with oil globules *in situ*, alkaline reaction, large amount of albumen—20 per cent or over—large amount of pus, mark the completion of the destructive process of which the hyaline casts mark the beginning and points clearly to a hopeless case of Bright's disease with rapid fatal termination.

*Pus* in quantity in the urine of alkaline reaction, no tube casts, no blood casts, large quantities of bladder epithelium, small amounts of albumen, indicate a case of cystitis.

*Blood casts* are only found in the urine in disease of the kidneys.

*Gonococci* may occur in the urine from the extension of an old gonorrhœa.

Small round concretions in the urine are evidence of stone. If intermittent hæmaturia also exist, it is probably in the ureter or pelvis of kidney, usually the crys-

tals present will indicate the character of the stone and a careful microscopical examination of the debris present will indicate its position. Stone cannot form in the kidney proper.

*Blood clots* cannot form in the bladder in the presence of an equal quantity of urine. Blood may be present in urine and not be perceptible by microscopical examination alone, as when the corpuscles are disintegrated and hæmin is found in solution in the urine. In this condition blood in the urine may be confounded with bile, aniline coloring matter, as in cases of fraud, or by urophæin, or melanin in melanuria, in cases of melanotic cancer of the liver, or by the phosphates.

When no corpuscles are present in urine which appears to contain blood, by calling in the aid of chemistry we are able to differentiate. We put a few drams of the suspected urine in the test tube and carefully add a few drops of  $\text{HNO}_3$ . If the coloring matter is vegetable, the urine turns yellow; if phosphate it is dissolved, if aniline color it is bleached, if melanin the urine turns dark and rapidly grows darker on exposure to the air; if bile is present we get a ring with the usual play of colors at the point of contact. But if the coloring matter is hæmin we get a slight precipitation and a slight ring of albumen forms at the point of contact. Then, by the application of Feichmann's test to a fresh sample of the urinary sediment we are able to produce under the microscope the hydrochlorate of hæmatin crystals, which is positive evidence of the presence of blood. In tubercular abscess of the urinary tract the bacillus may be found in the urine.

#### EXAMINATION OF THE BLOOD.

There is a number of diseases and diseased conditions, diseases of the blood itself, conditions characterized by abnormal changes in the constituents of the blood or marked variations in its normal constituents in which

an early positive diagnosis or prognosis can only be reached by microscopical examination of the blood. Fresh blood may be examined for plasmodium malaria and when found is positive evidence of malarial fever, also for the spirillum Obermier and when found is positive evidence of relapsing fever. For diagnosis of anthrax, and cases of filaria sanguinis hominis have been brought to this country from the tropics. Lukæmia, pseudo lukæmia, pernicious anæmia are diseases in which a Thoma-Zeiss counting apparatus and Fleischel hæmatometer are necessary accessories to the microscope.

*Examination of the exudate* by the microscope in cases of suspected diphtheria would clear up many doubtful cases and improve our statistics wonderfully. I know of many cases of follicular tonsilitis that were pronounced diphtheria and cases of diphtheria are at times pronounced tonsilitis. But there is a gradual increase in the number of physicians who are using microscopical methods to clear up doubtful and obscure cases of diagnosis and prognosis, and the time has come when the medical practitioner, be he general or special, must make use of this important means in diagnosis and prognosis or be left behind in the race.

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### On a Deep North Atlantic Deposit.

By A. H. MACKAY, B. A., B. Sc., LL.D., F. R. S. C.

SUPERINTENDENT OF EDUCATION FOR THE PROVINCE OF NOVA SCOTIA.

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Abstract of paper read 10th December at the Nova Scotian Institute of Science, Halifax, N. S.

The North Atlantic ooze was presented by Captain Troot of the S. S. "Minia" of the Anglo-American Telegraph Company a few months before, when the material was very soft and bulky. Since then the water has evaporated, leaving a hard mass of clayey mud less than one quarter of the original bulk. The material contains a large number of stones, pebbles and grains of sand, from

smallest size up to one of two or three pounds, as well as foraminiferous ooze, one portion of which was very much more clayey than the other portion. Captain Troot defines the position from which the material came as follows:

“Herewith the stones I spoke to you about. They come from a depth of 2450 fathoms in latitude  $49^{\circ} 50' N.$ , longitude  $40^{\circ} 15' W.$  The current in this vicinity runs strong to N. E., varying sometimes two or three points either way, doubtless influenced by the moon. The surface temperature ranges from  $54^{\circ}$  to  $59^{\circ}$  Fahrenheit. This is as it is found nearly all the months of June and July. A little farther west we found cold water and very little current. I am also sending some *Globigerina* ooze which came up in the same mushroom anchor with the stones—the anchor being full except on one side where it had been washed out while heaving up, thereby exposing the stones.”

The spot is therefore not far from 700 miles south by east of Greenland and something over 300 miles north by east from Newfoundland. It is beyond the Great Banks and well down into the profounder depths of the Atlantic, and just on the margin of the Gulf Stream, where it is tangent to that vast eddy whose circumference also sweeps drift from the regions of Iceland, brushes past the coast of Greenland and skirts the concave of Labrador and Newfoundland and to the Gulf Stream again.

The stones were mostly very black in appearance, as if encrusted with manganese; but on testing this color gave only the reaction of iron. The most abundant were compact and vesicular lavas. There were also present fragments of gneiss, hornblende and limestones dark and white. Quartz grains and mica scales also abounded in the sand. All these pebbles were apparently more or less water-worn, one specimen showing evidence of glacial polishing.

A proximate analysis of the two layers of ooze gave an average of about 25 per cent of carbonate of lime and 50 per cent of sand and clay for the one: and no more than 10 per cent of carbonate of lime and at least 66 per cent of sand and clay in the other. The most abundant species are evidently *Orbulina globigerina*. Then come *Sphaeroidea*, *Pullenia*, *Biloculina*, *Puloulina*, *Anomolina*, and *Rotalina*. There are also a few diatoms and sponge spicules.

The presence of the stones would seem to prove that the spot must be on the margin of the Arctic eddy, for the heavy stones cannot be conceived to be dropped into the midst of foraminiferous ooze except from melting ice. The temperature observation also shows that the position is near the margin of the Gulf Stream, for a little further west the water was cold and there was very little current. The sediment forming at such a point in the bottom of the Atlantic must therefore derive its material from a very extensive range of geological formations, possibly a very considerable portion being brought by glacial action ultimately from the highlands of Iceland, Greenland and Labrador.

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### A Method of Hermetically Sealing Cultures of Bacteria.

By CHARLES F. DAWSON, M. D.,

Assistant in the Division of Animal Pathology, U. S. Dept. of Agriculture.

In the November number of the "*Centralblatt für Bakteriologie und Parasitenkunde*," 1892, I published a preliminary note on a method for hermetically sealing culture tubes. At that time I was especially desirous of perfecting a seal to be used in making permanent cultures for exhibition at the World's Fair, in Chicago, in place of the clumsy and inefficient arrangements which had previously been used to prevent evaporation and final contamination.

Since publishing the preliminary note, I have had op-



portunities of testing the efficiency of the method. Out of about one hundred cultures sealed by my method, and placed on exhibition at Chicago, only about a half dozen became contaminated, and these few in all probability had the contamination in the cotton plugs before the seal was applied, they having stood for some days in the laboratory unprotected.

On account of the fact that by this method cultures can be easily preserved for a long time (probably for several years), it is of considerable value to teachers and to persons who wish to exhibit cultures publicly.

The special features of the method are that the seal is perfectly hermetical and is easily and quickly applied; it is transparent, and can be removed without destroying the culture tube, qualities which make the method eminently satisfactory for the purposes for which it is intended.

The method is as follows: Flame the end of the culture tube, and with a pair of flamed scissors trim the cotton plug down even with the mouth of the tube. Flame a thick cover-glass of the same size as the mouth of the tube, and lay it on top of the cotton plug. Soak a piece of sheet gelatine for one-half minute in a solution of bichloride of mercury, 1-1000. Remove the gelatine and knead it between the fore-finger and thumb. The heat of the hand will make it sticky. The gelatine is then placed over the mouth of the tube, stretched a little by passing the nearly-closed left hand over the tube. The cover-glass is for the purpose of preventing bulging out or sinking in of the gelatine cover from changes of atmospheric pressure inside the tube. Now place a small rubber band round the gelatine-covered end of the tube close up under the flange. After the rubber band has remained on for two or three minutes, pass a sharp knife round the tube between the band and the flange. The gelatine and band thus cut away can be removed.

The edge of the gelatine disc thus made must be pressed against the tube and outer surface of the flange, thus making a self-retaining cap. When this cap has become dry, which will ordinarily require about half an hour, it is given a coat of shellac varnish in order to insure a perfect joint, and to prevent the gelatine from being broken.

The varnish is applied by means of a camel-hair brush and is made from the following formula:

Absolute alcohol,.....	100 parts.
White shellac, .....	45 “
Bals. copaiba,.....	4 “

Allow this mixture to stand for a fortnight in a quiet place. At the end of this time an amber-colored supernatant liquid has formed. This should be carefully drawn off into a separate bottle having a paraffined cork stopper to prevent evaporation and adhesion of the stopper to the neck of the bottle.

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### EDITORIAL.

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**Death of Dr. Townshend.**—We are sorry to learn of the death, during the summer vacation, of one of our old subscribers, Dr. N. S. Townshend of the Ohio State University. He was one of the founders and one of the first Professors in the University. Of late he has not been so active as he was ten years ago, owing to his advanced years. He died at the ripe age of 79. He was one of the purest, kindest and most unselfish men we ever had the privilege of knowing personally. He did well his work and deserved his reward.

**Prizes for Work in Bacteriology.**—The Boston Society of Natural History offers prizes for 1897 for original papers entitled “Contributions to the Knowledge of Bacteria.” The prizes are of sixty and fifty dollars. For full information address the Secretary of the Society in Boston.

**Australian Association for Advancement of Science.**—We are pleased to receive a complete set of the Proceedings of this young and hopeful society. Its seventh meeting will be

held from January 3 to 10, 1897, under the presidency of professor Livesedge. Professor T. J. Parker is chairman of the section of Biology.

**A New Microscopical Monthly.**—We have received the *Zeitschrift für angewandte Mikroskopie*, octavo, 32 pages, price ten marks (\$2.50), edited by G. Marpmann, Leipzig. It deals chiefly with the technique of microscopy and partly with its scientific results.

**The Internal Structure of Calamite Leaves.**—Mr Hick of the Manchester Society examined some very small leaves; being those borne by the delicate ultimate branchlets, which looked more like those of a well grown *Chara*. He found them to be simple uni-nerved structures with a central, vascular bundle arranged on the collateral type and surrounded by a cortex in which can be distinguished an inner layer of cells with black contents continuous with a similar layer in the twig and styled melasmatic tissue. He also found an outer thicker layer of assimilating tissue. Surrounding the whole, he reports a single layered epidermis, consisting of cells of uniform size, with thickened outer wall. A transverse section of a leaf is similar in outline to that of a pine-needle. It is rounded on the under surface and more or less flattened above with a large median protusion above the vascular strand.

Heretofore, very little has been known about the leaf of the Calamite. More was known about the root, stem and bark. The microscopists of Manchester are being heard from continually though they have absorbed their society into the Literary and Philosophical Society and now meet as a section of the larger organization.

**Structure of the Spleen.**—The anatomists have for a long time desired some means for getting at the structure of this organ and have been largely baffled in their efforts to preserve parts of the spleen in the same condition in which they were when the animal was alive. The changes which organs undergo immediately after death—not to say during the process of dying—were too long overlooked, and are not yet sufficiently appreciated. Dr. Carlier has announced a method of overcoming the difficulty, substantially as follows: He first gives the animal an anæsthetic, paying especial attention to the complete

ness of the process. He then opens the thorax, removes the apex of the heart, fastens a cannula in the aorta, and washes out all the blood in the animal by irrigation with normal saline solution. This solution must be of the temperature of the animal's body. He then replaces the saline solution which has been injected with a strong warm solution of micro-corrosive sublimate. This penetrates the smallest capillary, at the same time killing and fixing every cell in every organ in a normal condition. The dissected organs may then be sectioned with a microtome and mounts prepared with which to study the structure of the desired tissue.

### BACTERIOLOGY.

**Bacteriological Examination of Two Hundred and Sixteen Cases of Diphtheria.**—Dr. F. Thymann (*Hospitals Tidende*, Nos. 10 to 13, 1895) examined bacteriologically 216 patients admitted to the Copenhagen County-Hospital with a diagnosis of diphtheria, his results being as follow :

Number of Patients	Appearance of the Fauces	Loeffler's Bacilli*	Loeffler's Bacilli*	Short Bacilli
19	Redness and swelling . . . .	12 cases	7 cases	0 case
29	Lacunar deposits . . . . .	10 "	17 "	2 cases
31	Small membranes . . . . .	16 "	12 "	3 "
133	Extensive membranes . . . .	98 "	34 "	1 case
4	Fauces not examined* . . .	3 "	1 case	0 "
216		139 cases	71 cases	6 cases

Amongst other cases the author mentions that of a child, age 1 9, in whom both tonsils and the uvula were entirely covered by a gray, fetid membrane; and, later, the tonsils were covered with deep ulcerations, the uvula being totally destroyed by the ulceration. Repeated examinations, however, only revealed the existence of streptococci. In all cases of tracheotomy the bacteriological examination of the secretion from the cannula gave exactly the same results as the bacteriological examination of the fauces, the total number being twenty-six. Of the 216

\* In all these patients tracheotomy was performed at once and the secretion from the cannula was examined bacteriologically.

cases mentioned above, 36 were complicated with croup, and only 3 of these were free from Læffler's bacillus. Dr. Thymann gives an interesting account of four brothers and sisters infected at the same time and in whom the bacilli found in all four cases were exactly alike, while the clinical appearance of the disease differed in all four.

**The Savages Are, Unconsciously, Bacteriologists.**—M. Dantec has demonstrated that the arrow poison used by the natives of the New Hebrides contains neither serpent venom nor vegetable extract. It contains two deadly disease germs—the vibron septique, which causes that form of blood poisoning known as malignant edema, destroying life in from twelve to fifteen hours if still alive, and the bacillus of tetanus, which if the former poison prove inert, will finish up the unlucky victim in a much longer time. The poison is obtained from the earth in certain marshy places. The horse cannot be the origin of the tetanus germ, as that animal is unknown in that entire group of islands.

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### **MEDICAL MICROSCOPY.**

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**Diagnosis of a Tumor by Blood Examination.**—Note from a Clinic by Dr. N. Senn. In the present case I can outline a tumor with rounded, lobulated margins, that I can push forward and upward, the dullness extending by the spleen. Having located the tumor we shall attempt to recognize its nature by a very careful examination of the blood. We locate the tumor anatomically with precision by resorting to insufflation of air per rectum, which pushes the tumor upward and outward, showing conclusively that it is an intra-abdominal tumor. The general appearance of the patient already indicates that this splenic swelling has interfered with the process of hæmatogenesis. It points to a serious affection of at least one of the principal blood-producing organs. I wish to show under the microscope the blood of this patient, which has been subjected to a staining process recently devised for recognizing certain pathological conditions of the blood, namely, with eosin. Under the microscope can be seen the eosinophilous leucocytes, or cells. And you will find the white corpuscles, or leucocytes, in the proportion of about 25 per cent; or one

leucocyte to every three or four red corpuscles: hence a serious change in the histological composition of the blood has already taken place.

You will recognize, in the specimen, leucocytes, which contain two or more nuclei. It is this multiple nucleus that is so characteristic in these cases. In the normal reproduction of cells, there is always some symmetry in the splitting up of the protoplasm in the formation of new cells, technically called karyokinesis. In these leucocytes no such characteristic process can be seen, but instead, there is an irregular splitting of the protoplasm; in other words, instead of karyokinesis you see here a beautiful picture of the process of fragmentation of the nucleus. It has been shown by Klebs and others long ago, that fragmentation is an entirely different process from karyokinesis, one meaning the reproduction of cells, the other a destruction of them. The nucleus is broken up in such a manner that it is unable to reproduce its own kind, and later undergoes molecular degeneration and is destroyed; hence the transformation of white into red blood-corpuscles does not take place. This is the reason why the patient becomes more anæmic, and is the direct cause of that progressive anæmic, and so invariably found in connection with splenic leukaemia.

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### NEW PUBLICATIONS.

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*Object Lessons in Botany from Forest, Field, Wayside and Garden.* By Edward Snelgrove, London, 1895, 297 pp. with 153 figures.

This book is well spoken of and designed to aid teachers in giving a course of 100 lessons to boys and girls, leading them over the paths by which they will discover scientific facts in the order and by the steps through which the original discoveries were made. We will speak more fully after having seen a copy of the book.

*Insect Life.* We are sorry to learn that this periodical has been discontinued. It was established by Prof. C. V. Riley a few years ago and strangely comes to its end at about the date of the death of its founder. We fear that an error has been made in suspending its publication.





MR. JOSEPH ZENTMAYER.

FOUNDER OF THE PHILADELPHIA OPTICAL HOUSE WHICH BEARS HIS NAME.



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On the Radiolarian Deposits of the States of Alabama and  
Mississippi.

BY K. M. CUNNINGHAM,  
MOBILE, ALA.

For several years past, readers of both Journals edited by Chas. W. Smiley have been treated to an interesting and valuable series of papers from the pen of the Rev. Fred'k B. Carter bearing on the study, classification and distribution of the Radiolaria. In one of the introductory articles, he kindly identified me with his work by quoting therein, from an article of mine, entitled "Diatomology" which had appeared somewhat earlier. But before the initial paper of his series had appeared in the AMERICAN MONTHLY MICROSCOPICAL JOURNAL, I had already put upon record the occurrence of Radiolarian-bearing chinks and shales in the vicinity of Enterprise, Miss. When I now reflect on the relatively simple and inconspicuous manner in which it was done at the time, in contrast to my present experience and familiarity with the deposits, I have occasion for surprise in several particulars. In my earliest study of the material, and with the object in view of putting it on record, I prepared about ten slides, and indicated the position thereon of about eighty of the Radiolarian bodies. I did this by means of dots of India ink on the cover-glasses, so as to enable the fossils to be easily found. These slides, ac-

accompanied with a descriptive article, were donated to, and placed upon record by the New York Microscopical Society. In the light of my present experience and familiarity with the deposits, the results noted above would appear to be trivial in comparison. With the greater experience since acquired, the same deposits can by proper treatment be made to yield their interesting fossil contents, sufficient for hundreds of slides at a time. The result of a single cleaning is that a momentary glance at a slide acquaints the observer with all of the curious and interesting features of the deposits. While the deposits are not of transcendent interest as regards the beauty or richness of the forms they have an interest, regarded from a geological standpoint, probably equal to that of the renowned deposits which have in past times contributed so much. The latter, already familiar to students of the microcosm, are usually and chiefly derived from the strata of marine islands which project their summits and slopes from deep blue seas, while these, the subject of this paper, are derived from sedimentary strata forming an integral part of our North American continent. The retrogressing waters from an ancient sea left these high and dry, but their sediments were doubtless laid down in a sea whose waves oscillated and pulsated in the Eocene period of the Tertiary, or in that just following the epoch of the "Chalk"—and whose sedimentary siliceous clays lap over the rocks of the cretaceous period.

Recently, and during the month of June, 1895, I had a favorable opportunity in which to study the characteristics of the strata yielding these Radiolarian clays. I was traveling due east on the public highway, from Quitman, Miss., to Butler, the county seat of Choctaw County, Ala., a distance of thirty-two miles. Along the route traversed, the summits of the axial lines of the Buhrstone ridges were crossed at frequent intervals, and over them

much might be seen of the natural outcrops as left exposed along the public road. The highest summit or ridge crossed had a probable elevation of some six hundred feet above sea level. Examinations made of the strata of various points, showed the material to be made up of various degrees of induration of the Radiolarian clays, ranging from complete flinty silicification to clays quickly softening to muds on immersion in water. The latter (readily reduced clays) were remarkable for the richness of the foraminiferal forms and for the simple arcuate sponge spicules contained therein. The various samples of rocks tested showed a variation in the richness of the contained Radiolarian bodies, some samples approximating a richness of fossil contents equal to the deposits derived from the Barbadoes chalks. They contained a relatively limited number of species in association, probably some twenty or more, but they might be aggregated together, or concentrated to any required extent. All of the Radiolarian clays of these deposits gave a combination of Radiolarians, Diatoms, Foraminifera, and sponge spicules. The spicules, as a rule, were of a rather complex pattern, branched and bifurcated on the order of elks' antlers. Owing to the difficulty of reducing or eliminating the amorphous clay matrix in which the fossils are embedded, the best results that the material is capable of yielding have not thus far been attained. I speak with reference to the richness of species contained in the material. My usual method for determining the presence and collecting the Radiolarians, is to triturate, or rub the softened clay on a small flat square of india-rubber. During repeated washings there is a final and complete elimination of all clay sediments, leaving the sand grains, mica, and various fossil bodies as a residuum. After this the silicious fossils of the several kinds may be secured by tens of thousands, but at the cost of destruction of the more delicate and minuter

species, and the breaking off of the spines of such species as may chance to have them.

I could find no process of acid treatment that would remove the amorphous clay particles which are an impediment to the concentration of the Radiolarian bodies. When a relatively large amount of the clay has been cleaned by the reduction process noted above, it then becomes possible by various expedients to get separately the spherical Radiolarians, and the Foraminifera. But the discoidal diatoms and flatish sponge spicules usually remain together. The very fine sand and mica scales are finally eliminated from the desired fossils, as they generally adhere to any Japanned surface, and may be blown away as of no use. The Alabama and Mississippi Radiolarian deposits owe their refractory nature largely to a metamorphosed condition characteristic of the Buhrstone horizon of the Tertiary deposits the world over. By silicious infiltration, sedimentary strata of a partially calcareous origin and containing spiral shells and minute foraminifera, have been silicified, as is clearly shown by the foraminifera, and the clay material itself resisting solution in the strongest of known acids.

The Radiolarian stone from Jeremie, Hayti, dissolves speedily in cold citric acid, which dissolves likewise the profusion of calcareous foraminifera, leaving intact the Radiolarians and sponge spicules, while the same natural rock has a flinty toughness. The well known Barbadoes chalk is soft and tender enough to be reduced and cleaned by boiling solutions of soda or potash. Both of the last-named deposits are strikingly different in the character of the fossils held therein. By comparison, the paucity of species as noted in the Alabama and Mississippi deposits will be seen. There still remains a probability that at some future time strata or thin layers may be found among those in Alabama and Mississippi of the same general character and richness, as noted

from extra North American localities. With these, microscopists are generally familiar.

At an earlier period, when I was less familiar with the Radiolarian clays and their method of preparation, I transmitted to Rev. Fred'k B. Carter some of the material for his study and examination, which proved to be a disappointment to him. This related to the ease of treatment, cleaning and concentration of fossils therein, as negative results seemed to obtain from such treatment as the material received at his hands. In order to compensate for the negative results, I made a small cleaning for his inspection and sent it to him with an urgent request to mount the same, so that there might be at least one competent witness to the presence of a Radiolarian deposit in this section. Complying with my request, he kindly examined the material and sent a list of the few species noted by him and comprised under the following Genera: *Cenosphæra*, *Ethmosphæra*, *Halioma*, *Actinoma* and *Elipsostylus*. At about the time of this approximate identification of the genera, I was preparing some notes on the micro-geology of Alabama. The names of these genera were introduced into the notes relative to the Alabama Radiolarian deposits, full credit being given to Rev. Fred'k B. Carter for his aid. Reference may be made to the Report of The Alabama Geological Survey, entitled "Report on the Geology of the Coastal Plain of Alabama, 1894."

Recalling, in this connection, the eloquent plea made by Rev. Mr. Carter, on a former occasion, for students to take up and pursue the study of the Radiolaria as a fruitful source of investigation, I volunteered to show my appreciation, and to lend my help in popularizing the study which he regarded as being neglected. With this object in view I sent him a large specimen of a Radiolarian chalk, thinking that anything, however barren in aspect, though giving promise of Radiolaria in return for its

proper treatment, would interest an enthusiast. Every diatomist knows what it is to run barren muds and clays through analysis and have in return disappointment. Some time after its receipt, Rev. Mr. Carter replied that much valuable time had been lost by him in its treatment, as he got nothing out of it for his pains. On my part I regretted this result, but about a year or so later, I was testing the identical material as sent to him from the locality of Andalusia, Covington Co., Ala., when I found that in every small cleaning made by myself, there was to be found a small uniquely shaped diatom of the *Triceratium* species.

Later, finding it had not been described or figured among the seventy-five species of known *Triceratium* listed in Wolle's *Diatomaceæ* of North America, which list as stated in his work included all known North American diatoms figured up to the date of publication, 1892, I determined to figure and describe it and place it upon record. I called it *Triceratium zabriskiei*. I sent a sample specimen of the chalk, a drawn figure of the diatom, and a slide preparation showing four of the *Triceratium zabriskiei*, along with the radiolarian and spicular fossils of the deposit, to the New York Microscopical Society, and added a description of its specific characters. The diatom as named and submitted by me was referred to in the *Journal of the New York Microscopical Society*, which fact fulfilled all the requirements that I had in view in naming it.

E. Thum's catalogue of 1895 enumerates three hundred and sixteen species of *Triceratia* in his stock of slides, while Wolle figured about seventy-five as the limit of known North American species. It looked a little rash to add a new name to the list of species, but a peculiarity of the Southern Radiolarian deposits will save this diatom from being confused with the European, Asiatic or African species already listed.

Any piece of the Andalusia chalk, as large as a marble, will give this exceptional form of a Triceratium, along with Radiolarians, sponge spicules and a few discoidal diatoms, chiefly *Coscinodiscus* with the treatment and manipulation suggested in the earlier part of this article. I think it opportune to state at this point, that if the process given by me herein is duly familiarized, and used by any student, he will have available an open door to a wide range of microscopical truth. If applied in many other directions, it will reveal to him many things of interest, that would otherwise remain hidden from his sight, and therefore be lost to his descriptive powers.

The time may yet come when the Geological Survey of the United States will find it useful as well as beneficial to have the microscopic structure, contents and composition of all of the Tertiary formations of the United States properly and adequately worked up, and out. In that case, the Micro-geologist, who is now unfamiliar with the beautiful results of Micro-geology, can, after acquainting himself with the data thus acquired, write with greater assurance, and more certainty. In the study of the earth's crust, the work of the microscope and its revelations are practically ignored. As a natural consequence it will necessitate some future historian to recast and unfold the genesis of the given stratum on a more scientific and accurate basis. This vein of thought was suggested by a partial perusal of the great volumes dealing with the Coastal Plain Report recently issued by the United States Geological survey, in which Assistant W. J. McGee in a masterly manner handles the whole of the Gulf Coastal Plain from Washington, D. C., to Texas. Therein, as a giant commander, he harmonizes and equalizes the combined work of all antecedent surveys. All this is accomplished without aid from microscopic sources. Among the chiefs entrusted with the direction of State geological surveys is Dr. Eugene A. Smith, Ph.D.,

Alabama State Geologist, whose kind recognition of the utility of the microscope to the practical geologist has enabled me to be of some assistance in the survey of this state. He has published a synopsis of most of the microscopical studies of the rocks, clays, etc., of several of the formations in Alabama, and from time to time has sent samples for determination out of which very useful results were obtained. More particularly has light been cast on the problem of the occurrence of a true cretaceous chalk in Alabama. A single casual outcome from the introduction from the word "Chalk" into the terminology of the Alabama formations has led to a prediction from an Ohio cement expert that Alabama in his opinion is destined to produce annually \$5,000,000 worth of cement from her chalk resources.

As one approaches Enterprise, Miss., from the north, at a point where two separate lines of railroads parallel each other, there may be seen a beautiful illustration of the stratification series of the Radioliarian-bearing rocks. The trains run through deep, but very wide cuts at intervals for several miles, when the observer will note the chalky whiteness of the almost perpendicular walls of the cuts, and the nearly horizontal layers succeeding each other with a regularity as if done by human agencies. As cut after cut is passed, the effect of erosion may be noted. The cuts present arched contours where the planes of the walls cut the hill surface, while the horizontal planes of the stratification do not exhibit any deviation from straight lines in their trend from north to south nor indications of the synclinal or anticlinal folds of the rocks of the carboniferous period. All of these thousands of thin layers represent a slow rain of Protozoan and other life during the aeons of the Eocene of Geology. They have been crystallized or molded, particle by particle, speck by speck, to form a part of our terrestrial globe. This rain still persists in the great oceans of to-day. It



was mostly from soundings taken by the Challenger expedition, 1876-78, that Radiolarian science was enriched with some four thousand new species unknown previous to their publication in the Challenger reports.

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## Microscopical Technique Applied to Histology.—XII.

[FROM THE FRENCH OF RENE BONEVAL.]

*Continued from Page 268.*

*Epidermis.*—Take the skin from the tip of the finger and make—

*Sections.*—To get a general view of the layers of the epidermis treat a small piece with alcohol and gum. Cut perpendicular to the surface; picro-carminé, glycerine.

*Eleidin.*—A section is stained on the slide by the following: picro-carminé, 1 per cent, 1 drop; distilled water, 10 drops. Examine by a low power, and when the grains of eleidin are red add the thin cover. Replace the picro-carminé by a drop of neutral glycerine allowed to penetrate slowly. This preparation will keep well. To see the eleidin grains disappear, treat another section, colored as described, with acetic acid glycerine.

*Osmic acid method.*—Put a piece of skin 1 mm. square and well freed from subcutaneous tissue, in a few c. c. of 1 per cent osmic acid. In 24 hours wash carefully in filtered water (12 hours), and harden in gum and alcohol. Sections, perpendicular to the surface, stained or not in alum carminé, will show the different layers of the epidermis with remarkable distinctness.

*Bichromate method.*—A piece of skin is left for a month or longer in a large quantity of 2 per cent ammonia bichromate (use 200 c. c. of solution to 1 c. square of skin). Wash in a large amount of water for 24 hours, harden in gum and alcohol. Make very thin sections perpendicular to the surface, and mount in carbolic acid water. This

is the best way to see the connecting filaments between the cells of Malpighi's mucous body.

*Union of the epidermis and the dermis.*—Take a shred of skin from a region where the epidermic layer is thin, and macerate it in the following: water, 150 grms.; acetic acid, 1 gram. In from 24 to 48 hours, seize, with the forceps, an edge of the epidermic layer and tear it off gently. You will thus obtain the epidermic<sup>2</sup> plates; examine the lower surface.

*The dermis.*—To the preceding methods by which this layer may be studied the following should be added:

*Elastic fibres.*—A section obtained after the action of alcohol is deeply colored by picro-carmin, washed, mounted in a mixture of glycerine, picric acid and formic acid. Also stain a section deeply with eosine and mount in a drop of 40 per cent potash solution. Also section as before, place in the following stain for 24 hours: dahlia grms. 0.2; alcohol, 5 grms.; distilled water, 5 grms.; dissolve and add: nitric acid, 2 grms.; water, 18 grms.; alcohol, 10 grms. After staining, treat with acetic acid and mount in balsam or in glycerine. In the last mentioned the preparation will not keep.

*Cells of the dermis.*—Treat a section by Erlich's method for granule cells.

*Cells.*—A piece 1 or 2 mm. square is put in filtered fresh lemon juice. In 10 minutes wash rapidly and put in a few c. c. of gold chloride. Wash again, and reduce in the  $\frac{1}{4}$  formic acid for 24 hours. Harden in gum and alcohol; mount the sections in glycerine.

*Blood vessels.*—Inject an amputated human finger. Treat a piece of skin from the tip with bichromate, gum and alcohol. Section perpendicularly to the surface; alum carmine, balsam.

*Lymphatic vessels.*—A hypodermic syringe with a short, fine-pointed needle is filled with the soluble blue; pierce the skin obliquely and inject. If an elevation is

formed, repeat; if it makes a spot by rapid diffusion, the preparation is a success. In this case inject the blood vessels with carmine gelatine, harden with bichromate, alcohol, gum; section perpendicularly to the surface; mount in balsam.

*Sweat glands.*—Take a piece of skin, as fresh as possible from the fingers, axilla, etc. . . . To fix, use alcohol, or bichromate, or osmic acid, following the proper methods for the reagent selected. Make thickish sections to show the tube, exceedingly thin ones to study the details. Stain with picro-carmine, alum carmine, or hamatoxylin and eosine.

*Sebaceous glands.*—Take a piece of the skin of the scrotum, treat for 10 days with 2 per cent bichromate solution. Harden in gum and alcohol. Stain some sections by hamatoxylin and eosine, mount in balsam; place others in a small tube containing picro-carmine. When properly stained (in about 24 hours), wash in water, expose to the vapor of osmic acid, mount in glycerine.

*Hairs; epidermis.*—Put a hair in water containing some 40 per cent solution of caustic potash. Raise the temperature slightly, scrape the surface with a scalpel, examine the result in a drop of the potash solution.

*Cortical layer.*—Put a hair on a slide in a drop of ordinary sulphuric acid. Cover and warm gently over a flame. To dissociate the cortical cells press the cover with a needle.

*The medulla.*—To study the medullary cells, take white hairs. Boil in a 40 per cent solution of caustic soda until the cells swell up and shrivel. Cover and examine with high power. If the cortical layer prevents observation, tease the hairs with needles. Entire series of medullary elements may thus be readily isolated.

*Sections.*— . . . . To a slide fasten a hair by one end with a drop of wax; repeat with a second hair, a third, a fourth, etc., side by side, softening the wax

with a hot needle. Spread a piece of diachylon plaster the width of the slide at the opposite end. . . . On the plaster place wax to hold each hair in place, fastening it by a heated needle. Treat the hairs thus extended and fastened side by side, with absolute alcohol, then by ether, taking care not to wet the diachylon. This done, wet with collodion so as to engulf them in a mass as the ether evaporates. Remove the layer of collodion containing the hairs and harden in chloroform. Imbed in paraffin. Make perpendicular sections. Avoid the use of clove oil, which would dissolve the collodion, but clear with bergamot oil or by benzine.

*Epithelial sheaths of the hair follicles.*—Take a piece of hairy skin as fresh as possible from which the hairs have been shaved. Treat with alcohol (24 hours), gum (48 hours), alcohol (24 hours).

Make two series of sections, some parallel with, others perpendicular to the surface. It is necessary to observe certain rules to obtain good longitudinal sections comprising the hair, the epithelial sheaths, and the papilla. The hairs not being inserted vertically but more or less obliquely, it is necessary to make the sections in the proper direction, as can be done after some experimenting. The best way is to make sections free hand and to make a large number with the razor variously inclined. Good sections should be stained by picro-carmin, and mounted in glycerine.

*The nails; dissociation.*—Place a bit of the finger nail in a drop of 40 per cent potash or of ordinary sulphuric acid, and warm over the flame. Cover and compress lightly. It is necessary to examine the preparation from time to time to avoid too great heating. With potash the horny cells swell up and show their nuclei. Macerate a fragment for 24 hours in ammonia; examine in the same after pressing on the cover glass with a needle.

*Sections.*—To be instructive these should include the

nail, the bed, the matrix, the subungual fold. With a pointed scalpel circumscribe the tissues about the nail, carefully grazing the bone. Place the whole in 90° alcohol (24 hours), then harden in gum and alcohol. Cut off longitudinal and transverse pieces; place these in a microtome, imbedding in cork, not in pith. With a strong razor cut the cork and the nail as if imbedded in pith. It is necessary to keep the material well wet with alcohol while sectioning. Very thin sections are not needed; . . . stain picro-carminé, mount in neutral or in acid glycerine.

*Nerve endings.*—We shall successively study the intra-epithelial nerve fibres, the corpuscles of Meissner and those of Paccini.

*Intra-epithelial fibres.*—From a perfectly fresh finger take from the palmar surface of the 3d phalanx, a piece of skin 1 or 2 mm. square. Removing the subcutaneous cellular tissue, place the skin in a mixture of gold chloride and formic acid (gold chloride, 1 per cent solution, 4 pts., formic acid, 1 pt.; boil and cool). In an hour transfer to water slightly acetified, and having removed the excess of gold, plunge rapidly in distilled water. Reduce the gold by day light (from 36 to 48 hours); place the piece in strong alcohol. Section perpendicularly to the surface. Mount in glycerine.

*Meissner's corpuscles.*—These may be well observed in sections made after osmic acid and alcohol. We will describe other methods, as follows.

A piece of skin from the pulp of the finger is put for 15 minutes in lemon juice. Wash; put in gold chloride or in the double chloride of gold and potassium for 1 hour. The reduction is attained in slightly acetified water in day light. This is accomplished very slowly (two or even many days), so a more rapid method has been sought. From the gold transfer for 12 to 24 hours to water; warm in a saturated solution of tartaric acid to 70° or 80° C.

In a few minutes, 15 or 20 at most, the pieces take a beautiful color varying from vivid red to deep violet. Too long warming will produce a black and granular deposit, which prevents observation. By experiment we reach the proper point. After either method, the piece is placed in strong alcohol. . . . Make sections perpendicular to the surface (in gum); mount in glycerine.

*Paccini's corpuscles.*—It is well to study these first in mesentery of a kitten. Spread out a portion of the membrane taken from near its point of insertion, and search for the corpuscles with a low power. When a few have been found . . . free them by needles from connective tissue and fat cells, and put them in a silver nitrate, 1 to 300. When impregnated with it, wash and mount in glycerine. . . . Into a very fresh human finger, in the course of the nerves inject with a hypodermic syringe 1 per cent osmic acid. After cutting the skin along the course of the nerve, take one of the pieces and dissect it. In the midst of the fatty layer, colored black, we see Paccini's corpuscles colored a clear translucent yellow. Collect them, free them from the debris of connective tissue, and plunge them into a 1 per cent solution of picrocarmine for 24 hours. Wash them, harden by alcohol. With a little practice, longitudinal and transverse sections may be made by imbedding in elder pith. Or they may be imbedded more easily in paraffin, as follows. From the 90° alcohol, they are placed in absolute alcohol (12 hours), then in oil of cedar for 12 hours, finally in paraffin. . . . The paraffin should be dissolved from the sections by benzine; mount in balsam. To see the capillary net work in the corpuscles inject the finger with the Prussian blue gelatine mass.

*To be Continued.*

## Microscopical Examination of the Sand Stone in the State Prison at Carson City, Nevada.

BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

Of course, having put forth the theory that an inland sea of vast extent, containing fresh water, existed some time previous to the Oligocene Tertiary, that is to say when the celebrated Monterey, California, and Richmond, Virginia, Bacillarian (Diatomaceous) deposit existed, I was bound to prove it in every way. I therefore gathered specimens from everywhere. I corresponded with numerous persons who could know anything about the supposed Occidental Sea. In this way I got earths from different parts and learnt something about the country. It is true that I had specimens gathered by the Northwest Boundary Survey and California State Geological Survey and also by the gentlemen connected with the United States Geological Survey. But this was not enough. I had crossed the so-called great plains in the cars twice, but I did not stop to get specimens. I only viewed the land from the car windows. It was flat, in fact truly a plain, watered very feebly and without trees. Growing upon it was sage bush but no grass. It cannot be wondered that it was called, by the first who crossed, the great American desert. Among the rest I got information of the occurrence of ichnolites at Carson City, Nevada. There were impressions in the sandstone looking like foot prints of men whose feet were covered by moccasins. Of course this caused a stir in the scientific world and elsewhere. For the sandstone was stone and placed by geologists in the Tertiary. I got the publications by Prof. Brewer and Dr. Harkness on the subject and I learnt all I could about it.

The fossil footprints are upon the layers of sandstone, not very firmly strong, in fact some of it is clayey. They are in a quarry within the state prison at Carson City,

Nevada, and, as I have said, excited considerable discussion. Prof. Blake, who examined them, does not say what they are. Dr. Harkness thinks them those of a man covered by moccasins. Certainly they do resemble human footprints. And the sandstone, it must be remembered, is ranked by good geologists as Tertiary. But Tertiary is a term not very uncertain, since Prof. Lawson says the Tertiary sandstone of Monterey, California, may be recent also. But if they are ranked as older Tertiary, Eocene, as I do, then they carry man and his footprints far back, and this is the earliest that man has been put without finding fossil bones to confirm it. I have examined the sandstone which I got with a portion of one of the footprints itself. For these I am indebted to Mr. Frank Bell, the warden of the state prison, and although the sandstone is coarse, containing very little clay, and therefore does not contain any Bacillariaceæ, as I at first expected, it looks like the sandy clay that is left when the water washed over it and thereby removed by solution the Bacillarian shells. That the shells of Bacillariaceæ are truly soluble, and very soluble, we have only to place on a filter some of the fresh water deposits, such as the Keene, N. H., or Weequatick Lake, N. J., and permit the water to flow through it. In time we shall find it grow smaller by degrees and beautifully less until it all disappears. In the Carson City earth the sand is left behind, being less soluble than the Bacillarian shells, or the shells pass down to a lower spot. We must look for them at a lower point.

Mr. Bell has an idea "that the sand hill is the bar formed at a mouth of a river in a large lake." Perhaps it is so, but I have not examined it personally. At any rate it was on the borders of a sea, the Occidental Sea, and Bacillarian shells are found near the bottom, as at Five Mile Canon, Virginia City, in Nevada. There is also



among the specimens Mr. Bell sent a fresh water mussel, a *Unio*, "such," as he says, "as are common in Carson river to-day."

The following section of strata is given:

Sandy clay .....	18 inches
Sandstone .....	4 feet
Clay .....	$\frac{1}{2}$ inch
Sandstone .....	16 feet
Fine clay .....	2 feet 2 inches
Coarse sandstone .....	10 inches
Sandy clay with tracks .....	3 inches
Sandstone .....	18 to 24 inches
Clay layer, with tracks .....	1 to 2 inches
Sandstone below the quarry floor .....	38 feet

So that the tracks seem to be in two layers, sandy clay and clay. The tracks are as follows: Elephas or the mammoth, elk or American reindeer, bos or buffalo, horse, wolf, tiger, peccary, mylodon or giant sloth, birds and the so-called "*Homo Nevadensis*" which it will be seen is contemporaneous with the others, the mammoth included. Prof. Marsh thinks these so-called *Homo Nevadensis* are not human but formed by edentates, and it appears reasonable. At any rate they are important and mark the time when man did or did not exist in the Eocene of the Occidental Sea.

Now as to why I make the Carson City deposit Eocene. You must include the Five Mile Canon, Virginia City, in it, because I believe that is the lighter portion washed from the Carson City deposit. I believe that they both, the Carson City and Five Mile Canon, existed at the same time and were contemporaneous with the Mono lake, Cal., and Utah deposits. Now when the sea was full of water and Bacillariaceæ deposited, there came a raising up of the bottom by volcanic agency. This volcanic agency formed the lava and trap that is found now all over the plain. It broke out in several places but more particularly in the Lassen's Peak region in California. Suffice it to say the water had to escape. This it did by the Columbia

river in Washington and the Colorado river in the south. Some of it escaped through California by means of Feather river and Sacramento and San Joaquin rivers. It flowed to the Pacific before the Monterey rock containing Bacillariaceæ was formed, and is older than that rock which contains marine shells and is contemporaneous with the Richmond, Pennsylvania, Spain, New Zealand, Algiers, and Denmark deposits. These are all Oligocene Tertiary.

I believe fresh water Bacillariaceæ were older than marine Bacillariaceæ. For they are found in the Newark (Triassic) sandstone and in the older Silurian.

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### Special Staining Methods in Microscopy, Relative to Animal Tissues and Cells.

By DR. G. P. UNNA.

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[Translated from the German by Geo. W. Cale, M. D., F. R. M. S., London,  
St. Louis.]

#### ACID NUCLEI.

The teaching of the relative independence of those micro-organisms, which we call cells, within the large organism of an animal or vegetable body, has been the predominating one for more than a generation. We think, conscious or unconscious, cellular physiologically or cellular pathologically (Virchowlogically, if I may be permitted to so express myself, even if in more recent times—and correctly—from different sides), noteworthy efforts are being made to detect the life peculiar to the intercellular substance and fluid tissues, and in part even to bring the anatomical cells under the jurisdiction of those substances. Although at present we do not deal with structureless “juices” and amorphous layers, but with substances the closer examination of which is made possible by the chemical reagent and the microscope, yet

these efforts remind us unconsciously of the per-Virchowian period where they worked with less efficient accessories; although we cannot fall back to that time, unequally balanced in being rich in imagination and poorer in knowledge, yet we have described a circuitous route, and at the same time approached somewhat the views of an epoch which knew only the central influences of strong power, but had yet no idea of the decentralization of life. This decentralization, the putting up of units of a lower order, has always and in all natural sciences proved itself to be the most effective lever of progress. What the atoms are for the physicist, the molecules for the chemist, the cells are for us. Although their anatomy may be ever so limited, we calculate with them and we think in them; and yet cellular pathology would not have taken such unrestrained possession of our minds during the last decade if it had not received a support of unknown power in the teachings of karyokinesis.

As the bulk of working power upon anatomical, yes, we can well say upon microscopical ground, had thrown itself upon the investigation of the wonderful play of the nuclear threads, and finding here for the first time rules and laws for a complicated substratum of propagation, the importance of which daily became enlarged, the independence of the single cell became established so impressively and in so tangible a manner, and for everyone who wished to see, as it had never been before.

Although the bacterial poisons, or auto-intoxicants, may still under certain pathological conditions on the one side, and chemotactic incidental peculiar juices on the other, there may forcibly and without consideration break in upon millions of cell individuals and claim the field in the more quiet work of reconstruction at least, and also in the most varied disturbances, progressive from the beginning, the faculty of propagation of the

single cell, and along with its independent value, steps undeniably to the front. Until now this view of the cellular pathology has held its own against the dangerous attack of Grawitz, who finds in already formed inter-cellular substances under certain conditions the matrix of a new cell growth. If, then, the positive karyokinetic pictures are at the present time the firmest support of the cellular pathology and the most obvious proof of an independent cell action, likewise it is certainly a question of the utmost importance whether we can immediately detect with the microscope in how far the existing cells of a certain tissue are capable of propagation. Of course, we do not always surprise them in this act, and we are often in the position to accept upon mere analogies a cell formation by division, where the unkindness of the specimen for examination will not permit us to give positive proof by the direct presence of a karyokinetic picture. In this condition it is certainly of special value for the specimen of normal or pathological anatomy if we possess a method which will inform us as regards the faculty of proliferation of the resting nuclei (the connective tissue cells, epithelial cells).

For some time past I have noticed a certain kind of nucleus in pathological structures, especially in chronic inflammation and new formations, which manifests itself by its especial size and stronger staining qualities. In some new formations—for instance, in leproma—these acquire a noticeable size; they are mostly of oval form, show a fine chromatine thread-work which is not essentially of greater staining power than the nuclear juice—and are surrounded by some protoplasm. As they take, with the use of certain stains of which I shall speak, also a meta-chromatic color in contradistinction to the ordinary nuclei, I subjected them to a more careful examination as regards their ability of retaining stains,

and noticed to my surprise that they act in their totality like an acid tissue. With the ordinary nuclei, as is well known, the acid media react most markedly upon chromatine threads and cell bodies only, and in such a prominent manner that these structures are capable in the presence of acids of retaining the previously-absorbed basic colors, and therefore permit themselves to be tinctorially isolated by acids. The great mass of the cell, above all the cell juice, on the other hand, reacts neutrally; or even in a basic manner; that is, it takes up the acid color and retains it in the presence of basic after-coloring. If we, therefore, allow a double staining with an acid or basic color to act upon a tissue which contains, aside from the ordinary nuclei, the above described total acid nuclei, we obtain a beautiful contrast stain between the two kinds of nuclei. Such a method is, for example, the one described by me—the Water-Blue Safannin Method. It shows us the ordinary nuclei blue with the exception of the (strongly acid) small nuclear body, the acid nuclei, however, stained a brilliant red in their totality.

If one needs only to obtain a special stain of the acid nuclei without double staining, all that is necessary is to decolorize with a concentrated tannin solution the sections over-stained with my polychrome methyl-blue solution or a gentian solution; they appear in the first instance violet, while the other nuclei are blue; in the second instance they show a red color, while the ordinary nuclei are violet. Altogether it gives the impression as though in these nuclei the reaction and tingibility of the nuclear chromatine had spread over the entire nucleus; and in consideration of the importance of the chromatine in the generation of new nuclei and cells the suspicion arises that the acid nucleus represents a pathological formation. This suspicion is justifiable in so far as one meets them in

large numbers in all pathological processes, whether these present themselves as inflammation, as progressive or as regressive disturbances of nutrition. However, their presence is not confined to pathological processes, as they are always present, for example, in fat tissue.

At all events, we have to deal with nuclear formations which are no longer fitted for propagation. For in those epithelial tumors (condylomata acuminata, carcinomata) where the acid nuclei are present in large numbers together with cell division, the latter are never surrounded by a basic-stained back-ground; a division formation in acid nuclei seems out of the question, and with it their propagative ability. With the conception of a sterile being we are accustomed to unite the idea of an early resting condition upon a period of rapid development, and at the same time of a tendency to unnatural body increase. We meet with both in the acid nuclei. I have already called attention to their large size. A study of them in benign epithelial tumors, especially in condylomata acuminata, shows that they are extremely stable formations. The acid nuclei make their appearance in the youngest epithelial row at the connective tissue boundary, and can be found with the same staining reaction, size and formation through the older layers until within reach of the horny layer; whereas the surrounding ordinary nuclei of all ages are subject to very obvious changes in size, form and tingibility.

As a consequence, we can hardly go amiss if we conclude that the acid nuclei by giving off to the nuclear juice the chromatine essential for reproduction have lost their faculty of propagation; have become sterile. If the conditions are really so, then we can by a proper staining of the tissue very appropriately make some statement in regard to their power of reproduction even though we

are not informed as to the wealth of cell division; namely, we can cast a glance at the opposite side of cell life and inform ourselves as to the number of cells that are excluded from the reproductive act. Where we find many acid nuclei interspersed amongst the ordinary (with acid or basmic reacting nuclear juice), there the cell new formation will remain in *statu quo*, and we will have suffered a modification in its power of reproduction. The *potentia generandi* of the cells of a tissue is in inverse proportion to the full development of acid nuclei. If, after accepting this view, we return to the line of thought outlined in the beginning, we cannot well do else than differentiate between nuclei and nuclei, cells and cells, according to whether they still possess or have lost the most important and highest characteristic of the phylogeny of cells, the power of reproduction. Of the first one cannot doubt an anatomy of the highest grade; the latter sink down to mere simple building stones of the tissue, and approach to the living intercellular substances. It appears to me, that according to this method of experimentation (chromo-chemical) we can, step by step, enter into the dark field of the life characteristics of the elementary constituent parts.—*St. L. Med. and Surg. Jour.*

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**The Malarial Parasite.**—Investigation is in progress in India by Surgeon-Lieut.-Col. Lawrie and Surgeon-Capt. P. Hehir of the Indian Medical Service and others. It began June 8, and continued daily till Aug. 15. Fresh blood was taken and stained preparations made from 116 cases.

They allege that they have found the microscope to be misleading and useless in the diagnosis of malaria and that there is no parasite in that disease. "There is nothing in pure blood but hæmocytes and leucocytes—red corpuscles and white cells." They declare the so-called parasite of malaria to be nothing more than a blue-stained nucleus of the leucocyte—the white cell. They say that the appearances described by Laveran and others are to be found in healthy blood.

### The Late Robert B. Tolles.

Extract from Handbook for Opticians by W. Bohne.

Tolles, Robert B. (1823-83), was born in Winsted, Conn. His father, Elisha Tolles, a farmer, spent a good deal of his time with mechanical inventions, several of which he patented; but like many inventors, was lacking in business ability, and never received much pecuniary benefit from them. His youthful son, Robert, was his diligent assistant, and early showed a decided inclination for all kinds of mechanical work. He made, while attending school, a very good violin on which he played for years. At the age of twenty-one, without knowing a particular trade, he was thrown upon his own resources with three sisters younger than he looking to him for support. In his helplessness he went to an uncle in western New York, but, disappointed in his expectation of assistance, he by chance stopped at Canastota, and visited the shop of Charles A. Spencer, where he found employment. We sometimes speak of a lucky accident, but in this case we rather should call it a beneficent providence, which enabled a master mechanic to detect at once the embryonic genius in the rough exterior of the young country boy. Under the direction of such a teacher he developed phenomenally his mechanical gifts and soon was able to execute the great ideas of his older friend. Many of Spencer's great achievements later on were due to the skill of Tolles. But when Spencer gradually enlarged his business, and associated himself with A. K. Eaton, for the manufacture of telescopes, Tolles concluded to start for himself, and limit his skill exclusively to the manufacture of microscopes. He rented a room in the railroad station, which served served him as workshop and bedroom. Here he worked to his utmost capacity, sometimes twenty hours out of twenty-four, including Sundays and holidays.



Orders flocked in from near and far. Meanwhile, the association between Spencer and Eaton had proved unprofitable; Eaton withdrew and left Spencer in a crippled condition. The old shop was breaking up, and most workmen went over to Tolles, who now rented the upper floor of an unused barn. Among these workmen were John Green, Austin Glidden and James Morrisou, as glass-workmen; and Charles X. Dalton, Orlando Amos, Clarence, the son of Spencer, and O. T. May (Spencer's son-in-law), as brass-workmen. In 1867 he moved to Boston, and established the "Boston Optical Works," under the patronage of several prominent merchants and manufacturers.

Tolles liked his occupation from the first day; it was most truly a case of love at first sight, and was verily a love that grew stronger and stronger as time went on and the possibilities in the field of optics opened up before him, and until it took complete possession of him to the exclusion of everything else. And to the end that he might achieve the best possible results in the line of his work, no man ever labored more devotedly or found greater satisfaction in the doing of his work than did he. But the story of his life has also its dark side, and only a few of the many who enjoyed and profited by the fruit of his labor were aware of it. For more than twenty-five years, and while he was doing his best work, he labored constantly under the great disadvantage of very poor health, and many a time he was at his work in his shop when most men would have taken a rest. In his younger days he had a severe attack of pleurisy which left a painful sensation in his side, aggravated always by the least cold or indisposition. Add to this the disadvantage, which many times proves quite as fatal to genius, of being poor—at times without the requisite means with which to prosecute his work under conditions that would insure

the best results from his inventions and discoveries, and we must admit that he was a martyr to his trade. He was poor all his life, and when he died in the hospital, he had no decent suit of his own to be buried in. The cause of his poverty was partly due to his poor judgement in money affairs. For instance, one day he received nine hundred dollars for work delivered, and as he generally was in debt, he paid out every cent, not leaving himself enough to pay for his dinner the next day.

The relation between Spencer and Tolles was always a friendly one; even when Tolles was at the head of a large shop, he took his work to his former teacher for examination and suggestions as to its quality and improvement. Spencer helped him in various ways; he aided him to get his patent on the binocular eyepiece, and assisted him enough on his solid eyepiece, to give Spencer the right to use it. *Only great men act in that way.* Tolles was not a scientific optician like Spencer and Zentmayer; he was not accustomed to figure out his formulæ with pencil and paper, but he got the greatest results by experimenting and by his unsurpassed mechanical skill. His greatest achievement was the 1-75 objective, somewhere about 1874, the only one in the world, and at present in the possession of Dr. E. Cutter, of New York.

Tolles' education was somewhat neglected. He therefore took to reading, and soon acquired a general knowledge of the arts and sciences as well as of the writings of the poets and select writers. He was very reserved and modest, and no one could vex him more than to mention any of his merits in his presence. He abhorred noisy company; it disgusted him, and he did not hesitate for a moment to show his dislike. He was well known in London and Paris, and received the degree of A. B. from Colby University, of Maine. In 1872, he had a lively controversy with F. H. Wenham, an optician of London, about

the measurement of the angle of microscopic objectives, which was published in *The Microscopical Journal*, of London, and in *The Boston Journal of Chemistry*.

He died in Boston, November 17, 1883, and was buried in Mount Auburn Cemetery. The sad news spread rapidly, and three days later Dr. George E. Blackham, of Dunkirk, N. Y., wrote the following beautiful eulogy to an intimate friend of Tolles: "I have just heard in a letter from Mr. Edward Bausch, of Rochester, of the death of my good friend Tolles. I need hardly to say to you how much this sad news has grieved me. The loss to microscopy throughout the civilized world is simply irreparable, but to those who had the happiness to be counted among his personal friends, there is something more than the mere eclipse of a great light in optical science. His lofty character, his frankness, his honesty, his modesty and dislike for anything that savored in the least of boastfulness, his peculiar reserve and the warmth of his friendship, when once the ice was broken, endeared him to his friends as much as his marvelous genius and unsurpassed skill in devising and constructing new optical combinations distinguished him in the world of applied optics. To the scientific world at large, he will live as the man who dared to attempt what the accepted authorities had declared to be impossible; as the man who not only dared to attempt, but succeeded in turning 'the 180° corner'; as the rare combination of artisan, artist and scientist, whose work was not made to sell only, but who, ever striving to surpass himself, wrought each new objective as if it were his only one, putting into each a portion of his own individuality, and making a work of art rather than an article of commerce. But to us who knew him more intimately, he will live as the shy, reserved, but warm-hearted man of genius. Standing at the very pinnacle of his profession, his death leaves a vacancy not readily filled."

The Microscopical Society, of Illinois, also passed resolutions of sympathy with his family. But these slips of paper form the only monument to his memory. The American opticians and microscopists have to the present day neglected to mark for future generations the spots where the remains of the greatest opticians of the world were laid to rest; *neither Tolles' nor Spencer's grave show any kind of lasting remembrances.*

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### EDITORIAL.

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**Cause and Prevention of Cholera.**—E. H. Hankin, a fellow in St. John's College, Cambridge, England, has issued a second and enlarged edition of his treatise on the above subject. He accepts the comma bacillus as always associated with cholera as its cause. He describes its getting into water, its growth, multiplication and death. He recommends disinfection of cells and methods for keeping micro-organisms out of the body.

**The Mails.**—A rule of the P. O. D. is as follows: "Disease germs, discharges of any kind from diseased persons, or other things of like character, no matter how securely put up" are excluded. In France it is permitted to send bacteriological specimens when put up in a mailing package especially designed for the purpose.

Dr. Henry Mitchell, Secretary of the N. J. State Board of Health has tried to induce a modification of this rule. The P. M. G. has refused. England and France laugh at our stupidity in accepting ignorant politicians as public officials.

**Louis Pasteur.**—The daily and weekly papers have been so loaded with notices of the death and life of this savant that our readers have probably become familiar with his work. In it all the microscope was his most constant companion.

His great work in bacteriology consisted in the attenuation of the anthrax bacillus and other pathogenic organisms by which he procured a vaccinating virus, capable of producing a

mild form of the disease against the attacks of the non-attenuated organism. It was applied in connection with fowl-cholera and with swine erysipelas, also with anthrax.

Among his early researches were those on crystals and wine fermentation. Later he attacked the diseases of the silk worm.

**Professor Theodore Gill**, of Washington, will be president of the Zoological Section of the A. A. A. S. at its Buffalo meeting which will commence Monday, August 24, 1896. D. S. Kellicott of Columbus, Ohio, will be Secretary of the same section. Professor Geo. F. Atkinson of Ithaca will be secretary of the Botanical section.

**Forthcoming Books.**—We are informed that a new edition of "Gosse's Evenings at the Microscope" is being prepared by Prof. F. Jeffrey Bell. "Milk; its Nature and Composition," by Dr. C. M. Aikman, will be published by A. C. Black. Lewis Wright is preparing an illustrated "Popular Handbook to the Microscope" to be published by the British Religious Tract Society.

**The Deep Sea.**—The deepest sounding which has been satisfactorily made in the ocean was near Japan, where 4,655 fathoms were recorded. Recently the English ship *Penguin* came upon a spot in lat. 23° 40' S., long. 175° 10' W. which is believed to be 245 fathoms deeper, but owing to an accident the exact depth has not been determined.

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## MICROSCOPICAL MANIPULATION.

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**The Best Method of Sharpening a Microtome Knife.**  
Dr. Lotsy thinks that Moll's method of sharpening microtome knives is the best, as "it allows one to put the knife in good shape inside of a few minutes for any section he wants to cut. Before using this method, any concavity of the knife-blade must first be taken away. Dr. Moll uses a plate of polished glass, which is fixed in a piece of wood, and two different powders, viz.—Vienna chalk and diamantine. A paste is made of one of these powders and put upon the glass; then the knife

is simply moved backwards and forwards upon the glass over the paste. By means of the Vienna chalk you can polish your knife in a very few minutes. The diamantine allows you to put a sharp edge on it, but does not give a polished surface, but rather a rough one. Now, when you have a knife which is highly polished, you can cut a section of, say, 5 mm. perfectly well; but if you try to cut with it a section of 1 to 2 mm., you will not succeed at all; your sections will become compressed and wrinkled, and you can do nothing with them. On the other hand, if you try to cut a section of 5 mm. with a knife having a rough surface, your section rolls up. This rolling up of a section has been represented to be a fault in the paraffin, but that is not the case. We must adapt the knife to every thickness of section we wish to cut. Starting out with a certain knife, if your section curls up, the proper thing to do is to polish your knife with Vienna chalk, and your section for that thickness will not curl up any more. If your section becomes too much compressed, your knife should be rubbed over the diamantine and the polished surface taken away, when the sections will be cut without compression."—*Johns Hopkins Hospital Bulletin*.

**Preservation of some Marine Animals.**—Mr. W. A. Redenbaugh says that while spending a few weeks at the U. S. Fish Commission Laboratory at Wood's Holl, Mass., he obtained some interesting results with Epsom salts in the preservation of many marine invertebrates. "The method of application requires modification in individual cases, but a few experiments will usually enable one to obtain the desired results. . . . Complete stupification of the organism must be produced, so that when it is removed to a killing fluid no contraction will take place. Care should be exercised, however, not to carry on the process too slowly, as maceration may ensue.

*Cœlenterates.*—The most beautiful results were obtained with sea-anemones, which ordinarily are so difficult to preserve in a well expanded condition. These were allowed to expand in a dish with as little water as possible. The crystals of magnesium sulphate were placed in the bottom of the dish and allowed to dissolve slowly until a saturated solution was obtained. The process of dissolving may be hastened, if necessary, by stirring

up the water gently from time to time with a pipette. Several hours were required to completely stupify large specimens. When narcotisation was complete, a few crystals placed in the mouth of the sea-anemone had no effect; but if the process had not gone far enough, the lips of the animal would slowly spread open, and then would follow sometimes a violent contraction of the whole animal. This method was tried upon *Metridium marginatum*, *Sagartia leucolena* and *Halocampa* products with excellent results, the tentacles remaining perfectly expanded after the animals had been transferred to Perenyi's fluid, picrosulphuric acid, or formalin. The same method applied to *Astrangea*, *Scyphistoma*, and various hydroids did not give as good results as those obtained with the sea-anemones. The polyps were not equally affected, so that only portions of the colonies were perfectly expanded. A large *Physalia* treated in this way was preserved in 4 per cent formalin, with all the tentacles and polyps fully extended.

*Echinoderms*.—Star-fishes and sea-urchins were killed with the ambulacral feet and pedicellaria well extended, by placing them upon the aboral surface for a short time in a saturated solution of Epsom salts, and then transferring them to 4 per cent formalin. The epidermis of the star-fishes, however, was rendered soft, and was subsequently easily rubbed off, but this was probably due to the formalin.

Specimens of *Synapta* were readily preserved without any constriction by very slowly and intermittently adding to the water, in which they had been allowed to expand, a saturated solution of  $MgSO_4$  (Epsom salts).

*Vermes*.—Most annelids, when placed in saturated solution of Epsom salts, in a very short time became perfectly limp, and were easily extended upon a glass plate and treated with a fixing reagent. *Balanoglossus*, when taken soon after being collected, was preserved in this manner in nearly a perfect state. It was necessary, however, to keep it in position between the edges of two glass slides when the fixing fluid was applied. Good results were obtained with *Cirranulus*, *Amphitrite*, *Nereis*, *Rhyncobolus*, *Clymenella* and *Phascolosoma*. *Phascolosoma*, in most cases, was killed with tentacles protruding. Nemertean worms when transferred to a killing fluid before being completely narcotised, sometimes protruded their probosces.

*Ascidians*.—Molgula and Cynthia were readily killed with siphons open after anaesthetisation with magnesium sulphate. In this case it is best to add the saturated solution of sulphate intermittently with a pipette.

*Ctenophores*.—After considerable experimentation, a method for preserving these delicate creatures in a nearly life-like appearance was devised. Formalin alone in solutions of varying strength had been tried without success. It was found necessary to treat the animals with some hardening reagent before placing them in the formalin, and the following method seems to be the most successful:—To a solution of equal parts of 2 per cent formalin and Perenyi's fluid was added enough common salt (NaCl) to increase the density of the mixture to that of sea-water—*i. e.*, until a Ctenophore placed in it barely floated. This adjustment of the density of the surrounding medium prevented the Ctenophores from collapsing of their own weight. After remaining for about half-an-hour in this fluid they were transferred to 4 per cent formalin, the density of which had been increased by the addition of either Epsom salts or common salt, so that the Ctenophores again barely floated. Epsom salts is probably better than common salt for increasing the density of the fluid. Some specimens which were preserved in formalin x NaCl began to shrink after a few days; while some (*Mnemiopsis*) which have been preserved for nearly six months in formalin x  $MgSO_4$  are still in excellent condition.

After the Ctenophores have been properly preserved, precaution must be taken in transporting them, for they are easily torn to pieces. If they are placed in bottles filled with fluid of the proper density and the cork so inserted as to leave no air-bubbles, this danger is reduced to a minimum."—*American Naturalist*.

**Microscopy on a Railroad Train in Motion.**—Going to Portland in August, 1895, I wanted to show a gentleman a Gordius hair worm (hair snake); vulgarly supposed to be born from horse-hairs soaked in water. With a one inch objective and a 1 inch ocular there was no difficulty in demonstrating the tubular head, the brown dark outlined body and the forked tail by means of my clinical microscope. The tube stage and eye all shook and moved together. I have used the clinical micro-



scope with 1.5 inch objective during locomotion on board ship in my berth, on a boat in a pond, using a white handkerchief placed at my feet for an illumination, at picnics when young ladies' white dresses gave the light. Doing away with the mirror gives more light and far less trouble in manipulation. I wonder it is not used more. Why use two articles when one is so much better?—E. CUTTER.

**Formula of the Wickesheimer Preparation for Preserving Objects of Natural History.**—The preparation of Wickesheimer, preparator of the Berlin University, for preserving animal substances for an indefinite period of time in their natural condition, has been purchased by the Prussian Government for free use throughout the Empire. It is used both by injection and immersion of the object, and is prepared as follows :

Take of Alum.....	100 grains avoird.
Common Salt.....	25 “ “
Saltpetre .....	12 “ “
Potash .....	60 “ “
(Common arsenic) Arsenious Acid.....	20 “ “

Dissolve these in  $1\frac{1}{2}$  gills of boiling water. The liquid is then to be cooled and filtered; and for each 5 gills add 2 gills of glycerine and  $\frac{1}{2}$  gill of alcohol.

For small objects it is sufficient to immerse them from 6 to 12 days in the solution ; larger ones are better preserved by injection.

**Microscopical Preparations of Algæ.**—M. A. Lemaire recommends the following process for permanent preparations of green algæ :—Fix in a saturated solution of uranium acetate with 0.3 per cent chrome-alum ; leave for six to twelve hours in the solution, and then wash thoroughly ; place on the slide in 2 or 3 drops of a 10 per cent solution of glycerin ; concentrate the glycerin under a bell glass by means of calcium chloride, and finally mount in Kaiser's glycerin gelatin, or Behren's glycerinated ichthyocol.—*J. R. M. S.*

**Studying Marine Planarians.**—Dr. Wheeler (*Journ. Morph.*, ix., 2), gives a few notes on methods he employed in the study of *Planocera inquilina*. The Biondi-Ehrlich stain proved to be useful in making the rhabdites conspicuous. Remarkably clear

pictures of the plexus and its connections with the brain may be obtained by killing in hot corrosive sublimate, staining for twelve hours in Czokor's alum cochineal, and, dehydrating, mounting in gum sandarac dissolved in absolute alcohol.

In a second paper in the same journal, Dr. Wheeler also describes the method of studying the nervous system of *Synchoelidium pellucidum*. The brain and nerve trunks may be readily seen in the living animal, but this is insufficient for study of details. It is, however, only necessary to stain with alum cochineal, extract as much of the stain as possible with water, dehydrate and mount directly from absolute alcohol in gum sandarac to obtain a diagrammatically clear picture of all but the very finest details of the nervous system. The nerves stand out as white lines on a darker background.

**Preservation of Sea-Weeds.**—Dr. J. P. Lotsy recommends the following method of preserving specimens of Florideæ, which prevents swelling of the cell-walls or contraction of the protoplasm, and preserves the chromatophores uninjured. The specimen is first laid in a 1 per cent solution of chrome-alum in sea-water, and kept there for a period varying from one to twenty-four hours, according to the size and texture of the species. The chrome-alum is then completely washed out, and the specimen placed in a mixture of 5 ccm. of 96 per cent alcohol in 100 ccm. water, and vigorously stirred. The amount of alcohol is then increased by increments of 5 ccm. every quarter of an hour until it amounts to 50 ccm. The specimen is then removed, and placed in a mixture of 25 per cent alcohol in distilled water, and the quantity of alcohol again increased in the same way till it amounts to 50 ccm. alcohol to 100 ccm. of water. The same process is again repeated with 50, 60, 70, 80, and 90 per cent solutions of alcohol in distilled water, the specimens being finally preserved in the last.

**Staining and Fixing Diatoms.**—Dr. P. Miquel finds the staining reagent best adapted for demonstrating the gelatinous envelope of diatoms to be an aqueous or boric solution of methylin-blue; which is not taken up so readily by the gelatinous stipe. The same reagent, especially in a slightly ammoniacal solution, may be used for demonstrating the nucleus, which is stained blue, while other substances contained in the cell take

from it a dark blue violet stain. For fixing, the author uses a solution of 65 gr. corrosive sublimate and 15 gr. sodium chloride in 100 ccm. of water.

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### MICROSCOPICAL APPARATUS.

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**Botanical Microscopes.**—Tyro (Chicago, Ill.). The study of plants botanically is not so difficult a performance as the uninitiated are inclined to imagine, nor are costly implements required for the work. Besides a thin-bladed knife the only tools required are needles of various sizes mounted in handles and a pair of delicate-pointed forceps. Our correspondent inquires what kind of microscope one must use for examining flowers. The reply is, Not the compound microscope. Any hand-magnifying glass, a pocket lens of two-inch or one-inch focus, or, still better, a glass of two lenses of different focus, will be found useful. The most convenient of these pocket lenses we are acquainted with is that known as Sayre's hand-dissecting microscope, which folds up like a jack knife and is so arranged that it is readily held in the hand holding the object under examination, thus leaving the other hand free to manipulate dissecting instruments. Some students get along very nicely with a good tripod lens, which they mount on a cigar box provided with a glass stage and a piece of mirror glass fixed at a proper angle.

More satisfactory than all these, however, are those simple dissecting microscopes made particularly for this and similar purposes and which are to be found in the shops. They consist of adjustable double or triple lenses, stage and reflector, and are to be had at a very moderate price, usually about two and a half or three dollars. One of these instruments consists of a block of wood large enough to stand firmly, the ends of which are beveled so as to make convenient hand rests; in a recess in one side of this block is a fixed mirror, while a moveable glass-stage-plate over the mirrors covers the recess. An upright metallic rod is fixed in the block and on this the magnifier with two lenses slides up and down.

There is another very desirable instrument of this category more compact and portable than the foregoing. It consists of a small  $1 \times 1\frac{1}{2} \times 4$  inch box with sliding cover. After removing the

latter the hinged supporting-rod may be placed in an upright position and the lens, double or triplet, stage, and diaphragm slipped on, all of which parts may be adjusted by simply moving them up or down the rod. The stage in this instrument is fixed by means of a thumbscrew. In one end of the box and directly beneath the lens when adjusted there is a small movable mirror. Grooves on the lower side of the lid carry a needle and dissecting knife. The two last-named features, however, are not found in some of these folding-box microscopes.

There may, of course, be had some expensive and complete dissecting microscopes; those here described, however, fulfil every practical purpose, excepting in cryptogamic botany and vegetable anatomy, or in the examination of pollen, in which cases a compound microscope is required. For detailed information our correspondent might address Mr. W. A. Olmsted, 182 Wabash avenue, Chicago, Ills., who make a specialty of school supplies of this nature, including everything connected with practical botany, such as botanizing boxes, flower presses, absorption and mounting paper, genus covers, etc. He would, no doubt, take pleasure in quoting prices and giving other desired information.

**Cheap Pine Wood Stand for a \$400 Objective.**—The following is told by the owner in whom we have full confidence. In July, 1895, the 1-75th inch objective was in Maine and no stand to use it with. Mr. R. B. Tolles had strictly charged that it never should be used save on a first class stand. Indeed, till now it had not been used on any but a \$300 Tolles or Zentamyer stand. But Prof. Moody of the Auburn High School was anxious to look through it and the time was short. So resort was made to the Irish Brothers mill at Buckfield. White pine 13 in. x 4 in. x 2 in. was planed smooth. In the median flat line 9 inches from the end, it was instantly bored, by a machine augur square through, with a hole, which after reaming, received the Boston optical works clinical stand. Two strips of pine 6 in. x 7-8 in. x  $\frac{1}{4}$  in. were nailed flatwise to the bottom 2 in. sides, projecting 2 in. each way for a base. Two like strips were nailed flatwise to the 2 in. sides, 4 in. below the hole and projecting 4 in. in one way for a stage basis; 3 in.

x  $5\frac{1}{2}$  in. x  $\frac{1}{2}$  in. pine formed a stage; 2 in. x  $\frac{1}{2}$  in. x 7-8 in. in duplicate held a 1 in. and 2 in. ocular for a condenser by a piece of thick paper  $8\frac{1}{2}$  in. x 1 in., folded with ends even and held between the duplicate pines by two small Indiarubber bands. The loop held the ocular. This pine stand was successfully used with the 1-75th as follows: Object, human red blood corpuscles, dry and uncovered; suitable field formed with a  $\frac{1}{4}$  in. objective on clinical stand, which was then placed in pine stand against the narrow edge of a oil flame (after Dr. O. W. Holmes). It was arranged so that flame, object, condenser, objective and ocular were in central alignment. The 1-75 in. was then substituted for the  $\frac{1}{4}$  in. objective focussed and condenser moved so as to give the best illumination. Besides Prof. Moody the following were among the hundreds who looked through this objective on a pine stand, Prof. Luther Whiting Mason, Ex-Governor Long, Prof. Butterfield and Mr. L. L. Tower of Massachusetts; Hon. Solon Chase, Hon. W. W. Stetson, Prof. Gilman, Superintendent J. H. Conant, Rev. Messrs. Lawrence and Statdler, with the Irish Brothers and families (Buckfield), Prof. A. H. Bradford, Dr. Da Costa, with Mrs. and Miss Bisbee (Rumford Falls) of Me.; Mr. J. W. McConathy of Ky., and many other teachers.

P. S.—When Mrs. Virginia M. Irish saw the pine stand she said “they (her husband and brother) must make you a better one from bird’s eye maple.” They did, burying the side pieces in the body and mounting the condenser on 1 in. x 2 5-8 in. x  $5\frac{1}{4}$  in. maple with a hole midway to fit condenser. It is an improvement.

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## BIOLOGICAL NOTES.

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**The Blood Corpuscle a Living Organism.**—The extensive researches of Dr. Heitzmann, of New York, formerly of Vienna, with reference to the structure of blood corpuscles, are more or less known to the profession, and are of exceeding interest. After a twenty years’ sojourn in New York, where his investigations have been carried on, he has recently revisited his native city, and in a paper of absorbing interest presented at the meeting of the Vienna Medical Society, the more important results of his microscopical investigations, par-

ticularly with reference to the structure and function of blood corpuscles. It was he who first satisfactorily demonstrated that blood corpuscles possess a reticular structure. He says that when treated with chromate of potash they show amœboid movements, and half an hour later filaments reticularly woven pass through the inside of the corpuscles, the hæmoglobin being enclosed in this network. This reticulum may also be found when blood is mingled with stale urine. The red blood corpuscles, therefore, possess life as protoplasm, the reticulum exactly resembling the living matter. Where much living matter is found the constitution of the individual is good. Dr. Heitzmann infers the nature of the constitution from the quality of the reticulum, and has been able to predict the end of an illness three weeks in advance by means of microscopical examination. The organism, he affirms, is a living, continuous structure, and not an aggregation of individual cells.

**New Micro-Organism in Pork.**—In my work as microscopist in the Bureau of Animal Industry I have commonly observed in various parts of the muscular system of swine undergoing inspection, with reference to the presence of trichinæ, a peculiar fungus. This fungus presented itself in the form of bundles of threads which have various colors and are intermingled with the muscle fibers, or found separate in a clump, under the field of the microscope:

Out of 1,000 hogs inspected daily at the government abattoir, I have found fifty, on an average, to be infected by this organism.

The parts of the carcass from which samples are taken for the trichinous inspection are the diaphragm, neck and loin respectively; hence, these were the parts in which I have usually found the fungus. As corroborated by Prof Miller, of Berlin this organism belongs to the *saccharomyces* or yeast group. It has very distinctive morphological characteristics, and I present for inspection pure cultures in every media which we have at our disposal. At a later time I will detail the peculiarities of growth of this organism in the various media and give the results of my experiments upon animals. A pathogenic potency of this fungus—*saccharomyces porcus*—is shown by the destruction of white mice and rats twenty-four hours after inocula-

tion. I have recovered the organism from the blood of these animals, which is found to be heavily laden with them.—Buffalo Med. and Surg. Jour.

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## BACTERIOLOGY.

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**Micro-Organisms in the Healthy Nose.**—Among the interesting facts we owe to bacteriology is the discovery that so-called healthy persons are the lodging places of myriads of bacteria, powdering their skins, dwelling in the cavities and orifices of the body, mouth, nose, throat, intestines, etc. It is calculated that 500 litres of air, bearing on a low average 1,500 bacteria, are inspired every hour. These microbes of the healthy nose have been investigated by Hajek, Lowenberg, Frankel, von Besser, Paulsen, St. Clair, Thomson and Hewlett, among others. The latter authors arrive at the following conclusions: 1, the vestibule is lined with skin furnished with hairs and with sudoriferous and sebaceous glands, and is not part of the nose cavity proper—only leading to it; hence in bacteriologic examinations of the nasal fossæ a distinction must be made between the vestibule and the mucous cavity proper; 2, contamination from the lining of the vestibule is difficult to avoid, even when this source of error is realized; 3, in the dust and crusts of mucus among the vibrissæ of healthy subjects micro-organisms are never absent—as a rule they are abundant; 4, on the Schneiderian membrane the reverse is the case. since in over 80 per cent. of the cases no organisms whatever were found and the mucus was completely sterile; 5, the occurrence of pathogenic organisms on the Schneiderian membrane is quite exceptional.

While the number of individual cases in these researches is hardly large enough to be conclusive, still, if they are corroborated, it would seem that nearly all the microbes of inspired air are arrested either by the moist surface and the vibrissæ of the vestibule, or that, as has been already claimed by Wurtz and Lermoyez, the nasal mucus is germicidal.

**Typhoid Bacilli in Ice-Cream.**—According to the *British Medical Journal*, an alarming outbreak of typhoid fever recently occurred in Paisley, England, in which eighty-six cases were traced directly to use of ice-cream manufactured by an ice-cream

vender on whose premises had existed a case of typhoid fever. The health officer who investigated the matter reported that the ice-cream was manufactured in close yards, and the articles used in the manufacture were flour, milk, eggs, sugar, and flavoring essences, which were for the most part stored in evil-smelling sleeping-rooms. In no instance were the shells of the eggs used broken. They were pierced at each end, and blown by the mouth, the perfect shells being sold to the proprietors of shooting galleries. Three samples of water taken from barrows and three samples of ice-cream were submitted to Dr. Klein, of St. Bartholomew's Hospital, on September 18. Dr. Klein reported that the first three samples were rendered turbid by small flocculi in suspension, and in each case there was a floccular white precipitate. A microscopic examination revealed in each of the samples of water and ice-cream an abundance of microbes.

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### MEDICAL MICROSCOPY.

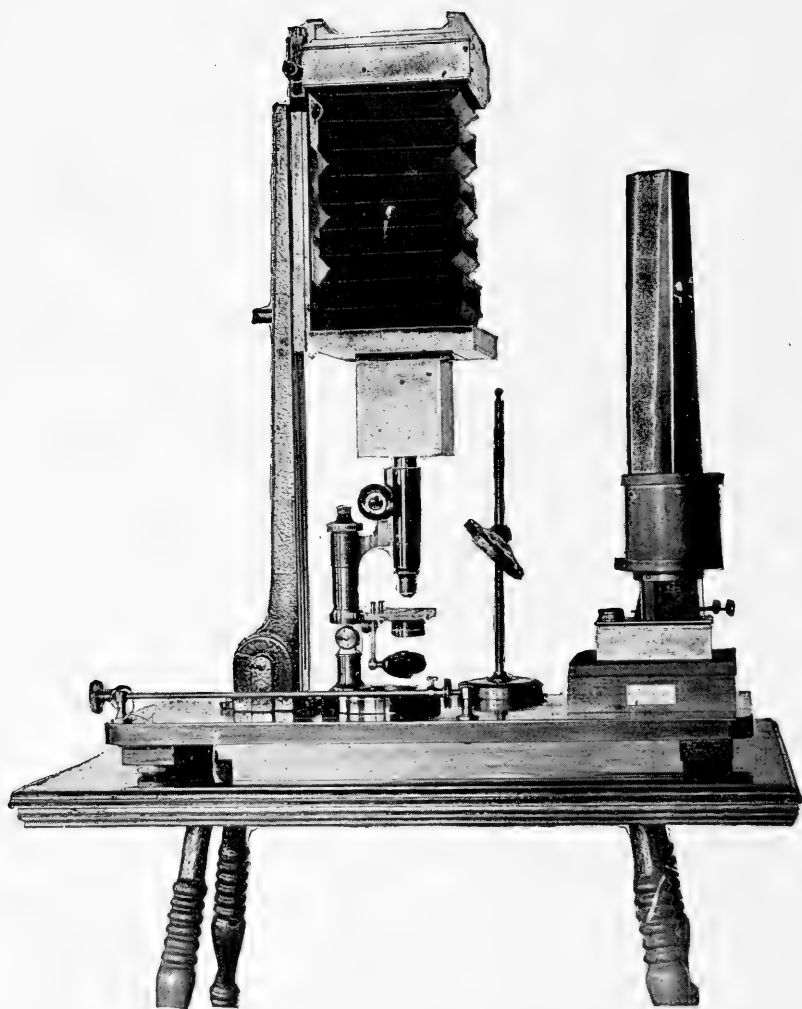
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**A Quick Method for the Filtration of a Small Quantity of Urine.**—For a very long time it has been a problem to know how, with the apparatus usually at hand, to obtain quickly and easily a small quantity of clear urine from a cloudy specimen in order to make the usual test for albumen.

The following plan, which has proved extremely easy and satisfactory in my own case, will I think, be found equally so in the hands of others: A small quantity of the cloudy urine is placed in a test-tube, and the mouth of the tube plugged with cotton to a moderate degree of firmness. A second test-tube is placed with its mouth to the first. The position of the tubes is now reversed so that the one with the urine is bottom upward. The upper tube is now carefully and gently heated over the flame of a Bunsen burner or an alcohol flame, and the expansion of the air above the urine immediately forces it through the cotton plug, and the filtered urine collects in the lower tube. In this way we imitate to a degree the rapid-filtering apparatus of laboratories, but use pressure above the fluid to be filtered instead of an air-exhaust below.—L. F. Bishop in *Boston Medical and Surgical Journal*.







THE NEW AUTOGRAPH CAMERA.

# THE AMERICAN

## MONTHLY

# MICROSCOPICAL JOURNAL.

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### Some New Points in Photo-Micrography and Photo-Micrographic Cameras.

WITH FRONTISPIECE.

BY W. H. WALMSLEY,  
CHICAGO, ILL.

Member of the American Microscopical Society.

Photography in connection with the Microscope, Photo-Micrography as universally termed, is now such an every day affair that one unacquainted with the facts can scarcely realize that only a few years ago its practice was confined to a very few enthusiasts at home and abroad, and its results looked upon as interesting and beautiful, but practically valueless. Yet such was the case in the later seventies, when Dr. J. J. Woodward was producing his marvellous Photo-Micrographs at the Army Medical Museum in Washington. His work was such a vast step in advance of any that preceded it, as to attract the attention of the entire scientific world, and in many respects it has never been excelled. Being confined however almost exclusively to the resolution, and delineation of difficult test objects—as diatoms and fine rulings on glass—its sole practical value consisted in the improvements in objectives, brought about by the efforts of many eminent opticians both American and foreign, to meet his exacting requirements. “The Battle of the Lenses,” will doubtless be remembered by most of you, and there can be little doubt that the wonderful improvements in and perfection of modern objectives, are due in a large

measure to the impetus given by Dr. Woodward in his efforts to obtain the best for use in Photo-Micrography. Indeed, Nobert saw for the first time the lines of his nineteenth band in a photograph made by Dr. Woodward with one of these object glasses.

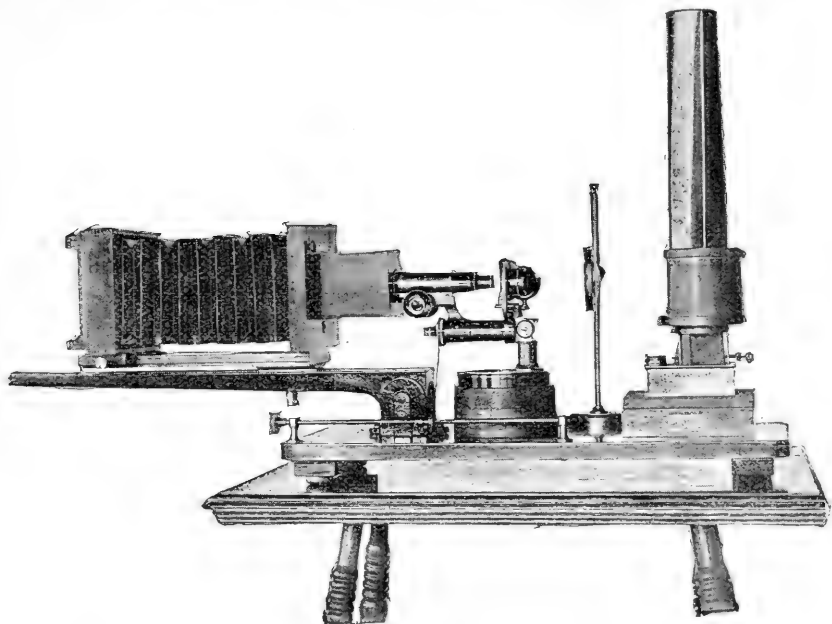
But even more marked in their effect upon Photo-Micrography, than the improvements in objectives, have been the changes in photographic methods, since Dr. Woodward's day. He worked within his camera itself, his workroom constituting a gigantic camera box, to which no ray of light was admitted during the focussing of the object and exposure of the plate save that which passed through the microscope.

The source of light varied according to time and circumstances. Usually he employed that of the sun through an immense heliostat, which is still in use at the museum. But as a very large proportion of his work was done at night, he also called in the aid of various artificial illuminants, viz.: magnesium ribbon, the lime light, and toward the end of his work, the electric arc lamp, each with unvarying success. Not being an expert photographer himself, this portion of his work was done by a professional, and it may not be uninteresting to know that colodion or wet plates alone were used. Gelatine emulsions were as yet unknown, or practically unattainable.

It will thus be seen that in addition to his own wonderful skill as a manipulator, Dr. Woodward had at his disposal unlimited government resources as aids to his researches and experiments. Indeed, it may be safely said, that no other worker in the same field ever was so liberally provided with the means for prosecuting it. The cost in every direction was deterrent to the most of less fortunate mortals, and as stated before, but for the many radical changes since made in photographic methods,

photo-micrography would still be the recreation of the few, instead of the practical realization of the many.

With the general introduction of gelatine dry plates of such exalted sensitiveness that the light of an ordinary lamp sufficed for exposures with quite high powers, and portable cameras adapted for use with any microscope having an inclinable body, the making of a negative of almost any microscopical object, was brought within the



reach of every worker. The printing, however, was not so satisfactory, especially where large numbers were required in the illustration of papers or books. But, as in the past, the steady advance in photographic methods, speedily supplied the existing need, photogravure and other *process methods* reproducing the negative in positive form with wonderful exactness, delicacy and cheapness, so that at the present day, papers upon any subject may be illustrated in a manner utterly unattainable a short

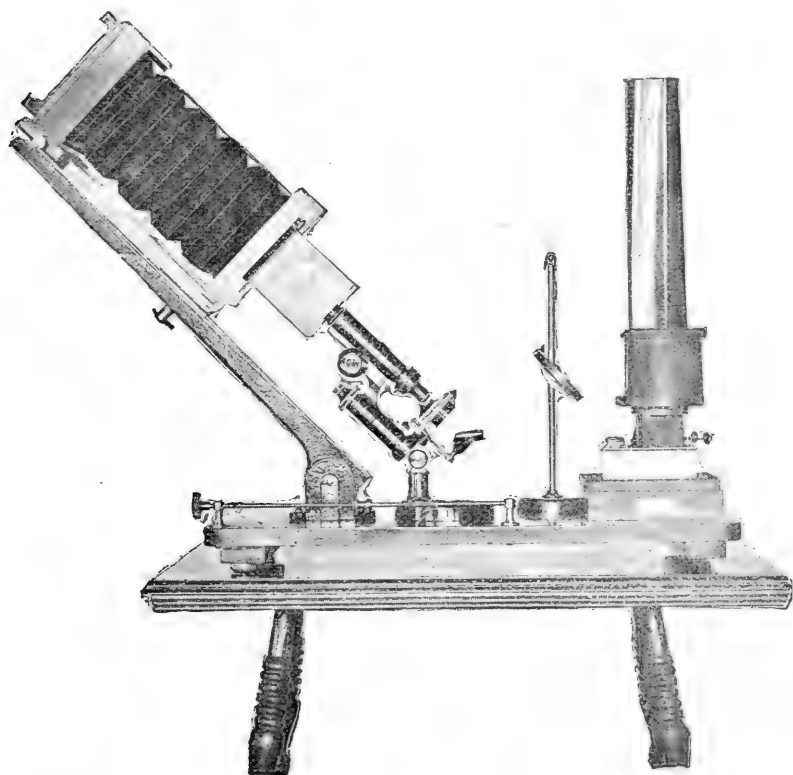
decade ago. By the same means, the optical lantern has been brought to the fore as one of the indispensable adjuncts of a well appointed lecture room. Ready sensitized plates of thin glass are now furnished at reasonable cost by several eminent makers, by use of which any one can make his own slides and from his own negatives, either by contact printing or by reduction in the camera, if he is provided with one adapted to the latter purpose. In short, the microscopist of the present day finds at his disposal the ready means of illustrating his work at every stage; and one who publishes his notes without illustrations finds himself at a disadvantage as compared with his more progressive brother.

It is not the object of this paper to do more than glance at the new points in photo-micrography which have fallen under the notice of the writer during the past score of years, and to call attention to a new form of camera combining some novel features, which he has recently introduced under the name of the "Autograph." It may be not uninteresting, however, if a very brief allusion is made to his preceding work in this direction, as he takes a perhaps pardonable pride in the belief that to his efforts, a considerable portion of the present acknowledged value and popularity of photo-micrography is due.

Without the slightest previous knowledge of photography in any form, I became greatly interested in its application to the microscope by my friend and mentor, the late Dr. Woodward. Many days passed in his work-room during my then frequent visits to Washington, gave me a keen relish for and desire to engage in this fascinating pursuit, without however the slightest expectation of ever being able to do so. The costly and complicated apparatus and appliances necessary, placed it quite beyond my reach, but in a few years, with the advent of portable cameras and gelatine dry plates, I became one of

the numerous army of amateur photographers, and very shortly afterwards, by means of a make-shift attachment to my microscope, produced my first photo-micrograph; a little affair, on a plate scarcely three inches square and not at all well done, but esteemed as almost a sacred treasure to the present day.

From this crude beginning was evolved the instrument



known by the lengthy title of the "enlarging, reducing and copying photo-micrographic camera," which I placed on the market early in 1882. It met with instant and generous recognition, and has maintained its popularity steadily ever since. So far as I have been able to learn,

it was the first American camera for this purpose to be produced commercially.

As indicated by its title, this camera is adapted to a variety of purposes. Any microscope with an inclinable body may be used with it in making a photo-micrographic negative, with or without an ocular. The latter is the usual method, since much more light is transmitted by the objective alone, whilst the long extension bellows permit a high magnification with any given lens. Dr. Woodward always worked without an eyepiece. With an ordinary photographic lens, the instrument may be used for enlarging, reducing or copying: the very long bellows rendering it particularly valuable for the latter purpose. It is, however, unnecessary to go into fuller details of the construction and capacities of this camera, since they are already so widely known.

Certain defects or rather want of adaptability to *all* purposes in this camera, led to the designing and construction of my latest box, the "Autograph." It was somewhat bulky, especially in the larger sizes, which in the too often contracted workroom, is a hindrance to its habitual employment. It could be used only in a horizontal position and the microscope must have a joint permitting inclination of the body, a feature not found in many otherwise excellent instruments, especially of German manufacture. For use with these stands a vertical camera is of course indispensable, as it is when the object is free in a fluid, such as yeast spores, blood, pus, and milk corpuscles, etc., etc. But for the great majority of work the horizontal position is the better, especially where it is desirable or necessary to use the direct rays of light from a lamp, without the intervention of the mirror. To meet these varying demands, the "Autograph" camera was designed, and it is believed successfully. It may be described as follows, the dimensions given being



those for a camera carrying 4x5 plates, the only size so far constructed. They would have to be proportionally greater for a larger sized box.

The base or platform is of polished mahogany or other hard wood, 26 inches long, standing upon three very short feet, to insure steadiness on any table or other support; the front end being heavily weighted beneath. At the other end of the platform a stout frame of japanned iron, 24 inches in length, with joint closed to its base is firmly bolted. This frame carries the camera, which slides freely in parallel grooves, milled in its upper surface, and can be secured at any desired point by a stout screw passing through a slot running the entire length of the frame in its centre. The joint permits the frame carrying the camera to be placed and firmly held in either vertical or horizontal positions, or inclined at an angle of  $45^{\circ}$ . For copying or making lantern slides from negatives, by enlargement or reduction, the latter position is almost indispensable, and is one of the most valuable "new points" embraced in the "Autograph" camera as will be seen presently.

The camera box is furnished with leather bellows of best quality, extending twelve inches, which has been found to be the most generally useful, though double that length can be employed if necessary or desirable. It is fitted with a reversible back carrying both focussing screen and plate holder, a most desirable feature, as it greatly facilitates the proper management of the object in relation to its position on the plate, where the microscope is unprovided with a rotating stage. The ground glass focussing screen is mainly useful for arranging the illumination, and the object in the field of view, its surface being too coarse to permit fine focussing with high powers. It may, however, be easily removed from its frame and replaced by a sheet of plate glass, when by

means of a suitable lens the nicest adjustment can be made. The plate holder is double and fitted with inside kits to carry  $3\frac{1}{4} \times 4\frac{1}{4}$ ,  $2\frac{1}{2} \times 2\frac{1}{2}$  or lantern plates, in addition to those of its full size,  $4 \times 5$ .

The front is fitted with a removal plain board to which an ordinary photographic lens may be attached, and an additional board carrying an extension, which may be oblong or cone shaped as desired, with an opening in its front end to receive the tube of the microscope. The flange of the photographic lens can be attached to this extension front if it be necessary to increase the length of the camera in copying and enlarging.

When the camera is used in the vertical or inclined positions, both coarse and fine adjustment screws are within easy reach of the hand and may be manipulated in connection with observance of the focusing upon the screen. But when the horizontal position is assumed, the distance is too great from the screen to microscope to permit this, and other means must be provided. A short rod turning freely in suitable bearings is attached to the base board on right hand side of the camera. To the end nearest the observer is fitted a large milled head and to the other a pulley wheel with V-shaped groove in its periphery, a corresponding groove being also turned in the micrometer screw of the microscope. This pulley wheel slides freely upon the rod or shaft, allowing it to be placed in line with the fine adjustment screw, where it is firmly held by a small set screw. A fine cord passed around the two grooves suffices to move the micrometer screw, when the milled head is revolved. This of course is an old and well known device, but being a good one has been adopted in this case.

The extension of the iron carrying frame beyond the end of the base board, with the additional weight of the camera acting as a lever, having a tendency to tip the

front of the base upward, a heavy iron bar forming one of the short tripod supports, is fitted beneath the front of the board, entirely obviating any such danger. The platform itself is of sufficient length to carry microscope, lamp and bull's-eye condensing lens on stand, the added weight of which serves also to give increased steadiness to the whole apparatus.

It is not within the scope of this already too lengthy paper to say anything in regard to the making of a negative from a microscopic object. This must be left to another occasion. But it may not be amiss to glance for a moment at the source of light for making the exposures. Diffused daylight, reflected from the mirror is probably the most generally useful illuminant and the various positions in which the "Autograph" camera can be placed give the day worker many advantages in its use. But most of us have perforce to do our work by night with artificial light. Fortunately there are many of these, some one or more of which are available to every one. The lime light (best of all in the opinion of many) the Electric arc, the Welsbach gas burner and the humble omnipresent petroleum lamp are all good, varying mainly in the differing lengths of exposure required with each. And finally we have the new Acetylene gas lamp, which places in the hands of every worker the ideal light for Photo-Micrography.

A few words as to the value of the "Autograph" camera in copying, and in making lantern slides by enlargement or reduction, and I will tax your patience no longer.

For both these purposes, the camera fitted with a photographic lens of not more than nine inches focal length and inclined at the angle of  $45^{\circ}$  is to be placed near a window and its base cleared of the microscope, lamp, etc. A carrying frame with its upper surface parallel with the camera front takes their place upon the platform, to which

the book, or print to be copied is fastened. The lighting, focusing and all subsequent details, are of course familiar to every photographer. I cannot even hint at them here, save to suggest that if the copy is for lantern purposes, it will be well to make it at once of the proper size to permit printing by contact, thus effecting a considerable saving of time.

Negatives of microscopic objects are generally made considerably larger than the dimensions of a lantern slide, though in some cases as a minute diatom for instance, they are much too small. In either case the lantern slide must be made by reduction or enlargement as necessary. For these purposes the camera is arranged precisely as for copying, except that its front end must face the window and be close to the latter. A large sheet of white paper is to be laid upon the platform as a reflector and on this the stand used in copying, and carrying a frame containing the negative, must be placed. A focusing cloth or other covering is then spread over the space between the frame and camera, so that no light may enter the lens save that which passes through the negative. The camera is then moved to or fro upon its ways, until the image projected upon the screen is of the proper dimensions when it is to be fastened in that position, the focus sharpened by moving the bellows and the balance of the necessary work of exposure and development done in the manner familiar to all who have mastered the simple mysteries of photographic manipulations.

The accompanying cuts fully illustrate the various methods of using the instrument.

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We are prepared to furnish blank applications for membership in the American Microscopical Society.

## Sponges Considered Microscopically.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

Sponges, or Porifera may be considered as representing a group by themselves. For a long time they were thought to be vegetables and even nowaday they are so considered by non-scientific persons. But now they are admitted to be animals, though what they are is doubted. We must take the classification of Profs. Nicholson and Lydecker, who give in their *Manual of Palæontology* a classification that is eminently satisfactory. Owing to the close likeness of some of the cell-elements of sponges to certain of the Protozoa, the entire group has been often referred to that kingdom. Thus some of the cells of a sponge are morphologically identical with the Amœba, that formless mass of jelly, while others present the closest possible resemblance to the flagellated infusoria. Hence a sponge has often been regarded as a kind of colony, the units of which are morphologically Protozoans. Naturalists are, however, now agreed as to the removal of the sponges from the Protozoa; and they are by many authorities regarded as forming the lowest division of zoophytes (Cœlenterata). Other authorities consider that the sponge represents a distinct morphological type, intermediate between the Protozoa and the Cœlenterata, and that they are therefore entitled to rank as a separate sub-kingdom, to which the name of Porifera has been given. This is the classification that I have adopted here.

They may be defined as "multicellular organisms of variable shape, the cells of which are typically disposed to form an outer membrane, an inner membrane, and an intermediate stratum; and which are traversed by canals which open on the surface, and which are more or less extensively lined by flagellate cells. In most

cases the cellular aggregate is supported by a framework of horny fibres, or of flinty or calcareous spicules. A definite mouth and stomach are wanting, and a nervous system is not known with certainty to be developed." The water which takes the food into the sponge goes in by the "pores" which occur all over the organism. Here it is passed into the "inhalent" canals. These conduct to the "ciliated chambers" which go to the "exhalent canals" and into the cavity which is in the center of the sponge. Here it is voided by a larger opening at the top which is known as an "Oscula." This is the typical sponge. The oscula, though capable of being temporarily closed, are permanent, and are often placed on chimney-like elevations. What is commonly called a "sponge" may consist of only a single excretory opening or "oscula," together with the "pores" belonging to this; or it may consist of a larger or smaller number of such "oscula," each with its proper complement of "pores." In the latter case, each oscula, with its accompanying pores, constitutes a "person," and the entire organism is known as a "sponge stock."

There are a few sponges of which no skeleton of the above description can be found, these are known to science as the Myxospongiæ. In the vast majority the soft cellular body is supported by more or less extensively developed hard structures; which collectively constitute the *skeleton*. There are four types of the skeleton. First, in certain sponges (such as the common bath sponges) the skeleton is composed of netted horny fibres, without the proper "spicules." The substance composing the fibres in such types is allied to horn, but not precisely of the same nature, and it is known as "spongian" or "Kenatose." Such sponges can be mounted very easily, only washing them in alcohol, or rather a small piece, and transferring it to a solution of gum thus. The preparation shows nicely.

Then there is another group in which the sponges are the most common. In this the skeleton is more or less extensively composed of siliceous needles or "spicules" of various forms. They can be mounted entire to show the sponge as it lives, or they can be pasted, but not too long, experience will show how long, and the spicules mounted after drying in gum thus. These spicules may be imbedded in various ways in a reticulated fibrous skeleton of spongian; or the horny material may be greatly reduced so that the skeleton-fibre consists essentially of minute flinty needles. There is a third group in which the skeleton is destitute of horny matter, but spicules are present. They may be fused with one another into a continuous framework, or may be so interlocked by their ends as to produce practical rigidity, or may be simply held in position by the fleshy substance of the sponge. In both this group and the preceding, in addition to the spicules of the proper skeleton, there are generally developed in the mesoderm numerous still more minute microscopic needles of flint, which are known as "flesh spicules;" and, lastly, there is a group of sponges in which the skeleton is wholly made up of spicules of carbonate of lime. In these of course in mounting them acids must not be used as they will dissolve the spicules. They must be cleaned by boiling in caustic potash or soda, washed in water and mounted in gum thus.

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**The Penetration of Microbes into the Blood.**—M. Nocard reported at a recent meeting of the Society of Biology Paris, experiments by which he has been able to demonstrate that microbes are capable of entering the blood through the alimentary canal. He found that, while the blood is usually sterile after an ordinary meal, a few microbes being found in the blood, after a meal containing a considerable quantity of fat microbes were found very abundant. His theory is that microbes are conveyed into the blood by the small fat globules, which are taken up by the lacteals.—*Druggists Circular*.

## Microscopical Technique Applied to Histology.—XIII.

FROM THE FRENCH OF M. RENE BONEVAL.

## THE EYE.

*(Concluded from Page 342).*

*The Cornea.*—Select the cornea of the frog, the rabbit, or from man if you can get one perfectly fresh.

*Impregnation with Silver.*—To make a negative impregnation rub a stick of silver nitrate over a frog's cornea left in place, then take out the eye and put it in distilled water.

With fine scissors remove the cornea, scrape both surfaces to remove the epithelium and mount in glycerine or in balsam. A frog's cornea thus treated is left for two or three days in distilled water; then mount it in glycerine or in balsam. The intercellular spaces have become clear and the cells are stained black. This is the *positive* impregnation.

*Impregnation by Gold.*—Put a frog's cornea in lemon juice or in a weak solution of acetic acid (1 per cent) for five or six minutes. After sponging off with bibulous paper transfer to a 1 per cent solution of chloride of gold for seven or eight minutes. Transfer to the acetified water. Usually the reduction is complete in twenty-four hours and the cornea has a beautiful lilac tint. Scrape off the epithelium and mount the cornea in glycerine. If the thickness prevents observation, with a sharp razor cut sections parallel with the surface and examine as the entire cornea was examined.

*Fixed Cells.*—Put a frog's cornea on a slide and expose to the vapor of iodine. When colored brown, scrape off the epithelium and examine with a high power. If not sufficiently colored expose again to the iodine. The network of fixed cells is colored with remarkable precision.

Put the cornea of a frog, a rabbit, man, etc., in a saturated aqueous solution of picric acid. Harden in gum



and alcohol, section perpendicularly to surface. Stain when free from gum, in picro-carmin, mount in acid glycerine.

*Sutural Fibres.*—To see these, prepare the cornea of a plagiostomal fish, the skate for instance.

*Nerves.*—Remove the cornea from a living frog, and place it in the following liquids: Filtered fresh lemon juice for five minutes; chloride of gold, forty minutes; acetified water. After remaining in the last for from twenty-four to forty-eight hours, the cornea has become violet and the nerves are properly colored. Scrape off the epithelium; examine in glycerine.

*Nerves of the Epithelium.*—Impregnate several cornea as described in the preceding paragraph. Mount one in glycerine without scraping off the epithelium. Put another in strong alcohol for twenty-four hours; section perpendicularly to the surface. If the hardening is not sufficient to allow of sectioning, finish by gum and alcohol. The nuclei of the fixed cells appear only when the cornea is dead.

#### THE IRIS.

*Muscle.*—To study the muscular fibres of the iris take the eye of a white rabbit. Divide it into two segments, anterior and posterior, separating them so that the anterior shall contain the entire iris. Place this segment in the  $\frac{1}{2}$  alcohol for 24 hours. Then carefully detach the iris, brush both surfaces to remove the epithelium, stain in picro-carmin, and mount in formic acid glycerine.

*Nerves.*—Treat the iris of a white rabbit by lemon juice and gold chloride, following the technique described for the demonstration of the corneal nerves.

The epithelium of the iris will be studied in the sections of the whole eye.

#### CRYSTALLINE LENS.

To dissociate the fibres of the lens we will employ Max Schultze's method. Place the organ in the following

solution: Distilled water, 30 grams; sulphuric acid, 4 drops, (Schultze uses an acid, sp. gr. 1.839). At the end of twenty-four hours' maceration it is sufficient to agitate the lens in a drop of the liquid to obtain a great number of perfectly isolated fibres.

#### THE RETINA.

*Sections of the Retina of the Crested Triton.*—The whole eye suspended from a cork, is exposed to the vapors of osmic acid. In ten minutes transfer to the  $\frac{1}{3}$  alcohol, and by a circular incision made with fine scissors, divide into two segments. The posterior segment contains the retina and is left in the alcohol for some hours. Transfer to picro-carminine for a few hours. Thence transfer it to two or three c. c. of osmic acid, 1 per cent. This reagent fixes the easily changed elements of the retina. Wash to free from the acid, and put in strong alcohol. In twenty-four hours the hardening will be sufficient to allow of free-hand sectioning. These sections are beautiful, but great skill is needed to make them. Imbed in paraffine, in which the elements are not sensibly altered, and mount in glycerine or in balsam.

*Dissociation.*—Place an eye of the crested triton in 1 per cent osmic acid. In twenty-four hours incise the ball on a level with its equator, and place the posterior segment in distilled water to macerate for two or three days. Remove a fragment of the retina with curved scissors, and dissociate on a slide with needles. Picro-carminine; glycerine. To macerate the retina fixed by osmic acid we may use the  $\frac{1}{3}$  alcohol, iodised serum or very weak chromic acid.

#### SECTIONS OF THE WHOLE EYE.

It is sometimes necessary to make sections including the organs of the eye in their respective positions. We cannot dream of using a simple method, for it is abso-

lutely necessary to combine many proceedings intended to obtain a faithful fixation and a proper hardening.

*Fixation.*—The fixing solution should be very penetrating, for the tissues forming the different parts of the eye are of very different consistence. These are membranes, like the sclerotica and the cornea, which possess considerable consistence, and are consequently but slightly permeable by the fixing liquids. These two membranes placed at the outside of the eye ball surround the other parts and prevent the penetration of liquids into the interior of the organ, and the fixing of the elements composing the contents of the ball. It is necessary to soften the sclerotica to allow the fixing liquid to pass more rapidly. For this purpose we use acetic acid, added to the fixing liquid. The latter is composed of chromic acid, picric acid and, in some cases, of osmic acid.

Aqueous solution of chromic acid (1 per cent), twenty-five volumes; saturated aqueous solution of picric acid, ten volumes; water sixty-five volumes. Add a few drops of acetic acid. To fix the elements as perfectly as possible it is indispensable to add to the mixture two volumes of 1 per cent osmic acid.

Place the whole eye in the mixture, and in four or five hours, when the ball has acquired a certain consistence, cut it in two so that the section shall pass through the optic nerve and the middle of the cornea.

*Hardening.*—Transfer these hemispheres to water, and leave them for three or four days to remove the picric acid and the color produced by the picric and the chromic acids. Then plunge them into Muller's fluid or into alcohol. The eye should remain for at least two weeks in Muller's fluid, after which wash carefully, and stain in mass with borax carmine. If alcohol is used transfer successively to the stain, then to alcohol at 40°, 60°, 80° and 90°. Stain in mass by borax carmine. Imbed in paraffin or in celloidin.

### EDITORIAL.

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**American Microscopical Society.**—Having been absent in Europe during July, August, and September we have not kept the society in mind so much as we did last spring. We trust, however, to show that we have not forgotten it. As we have three times as many readers who are not members of the society as we have of those who are, we shall try to keep the society alive in their memories.

A letter just received from one of the latter says: "Please tell me how I can become a member of the society. I have seen by the JOURNAL that the dues have been changed." In reply: Send your name to the secretary, Dr. Wm. C. Krauss, Buffalo, N. Y. He will probably supply you with a blank application for membership. That blank calls for the endorsement of two persons who certify that you are a suitable person. Do not be scared by that scare-crow. Members often explain that "it is a mere matter of form." And so it is. The endorsers often are people who never saw the candidate. The Secretary will often fill in one of the spaces with his own name when he feels sure that the first endorser is all right. Theoretically, the requirement is to keep out cranks and mischief makers. Practically the cranks and mischief makers get in, and lots of modest, earnest learners, fearing that their knowledge of microscopy is too small, hesitate to apply for membership. We do not think that any sincere and modest student of microscopy will be rejected on account of his meager knowledge. At any rate, we venture the assertion and ask to be corrected by "the powers," in case we are wrong. We shall be more than delighted to investigate and report upon any case rejected. As a matter of fact, we have never known an application to be rejected. It might occur, however, and no one except the candidate and "the powers that be" ever know of it. In this connection, we invite the secretary to prepare a clear and concise statement of the qualifications for our next issue and to supply us with enough blank forms so that we may enclose one to every subscriber. We offer the entire influence of this periodical to help build up the society. If the Secretary and members cooperate and send in their contributions, the society will profit thereby. If they do as they have

often done in the past—sit still in silence—they will have themselves only to blame—not us.

By contributions, we mean not merely scientific results of labor. We refer to suggestions looking to the development of the society and its plans. At this moment, we and our readers want to know all about the new secretary and his hopes and purposes. We want his portrait and a sketch of his life from some appreciative friend. If he chooses to speak through these columns twelve times per year to the membership in the interests of the society, he shall be entitled to all the space he requires. If he has nothing to say, eleven out of the twelve months, he is not realizing his duty. That society, like every other society, must live on enthusiasm or die. It came near dying in 1892, 1893, and 1894. This year it seems to have recovered considerable lost ground, for the moment. No one needs to do anything to throw it back into its cataleptic condition of 1892-'4. Simply do nothing and it will be there. An annual meeting of this sort cannot be neglected till a few weeks in advance and then succeed. You should begin now, Messrs. Mercer, Pennock, Latham, Krauss, Eigenmann, Schrenk, and Booth, to create in peoples' minds the idea that the 1896 meeting is to be so excellent that they cannot afford to make plans that will interfere with their attendance. The summer schools, foreign travel, seashore and mountain vacations, other societies without limit, public and private interests all stand in competition with you. The older and best members of the society are not going to give up superior attractions for the sake of the society meeting merely on some vague sentiment—such as "loyalty to the organization." Unless the organization shows its loyalty to the membership by furnishing them enthusiasm and superior attractions the membership will laugh in the sleeve when they are exhorted to loyalty. Loyalty begets loyalty. Apathy produces apathy. We call on the new officers to announce their programme. Is it loyalty or apathy? We forewarn our readers to look in this for communications from the seven persons above-named in response to this question: "What can you, the members and the JOURNAL be doing *at once* towards making the 1896 meeting the best ever held?"

Some things the JOURNAL can do. We now offer free of all charge, an advertising page (worth \$100 dollars per year) to

the Secretary in which he may make any and all announcements he pleases regarding the society, in every issue of the JOURNAL.

As above intimated, we will bind into every number a blank application for membership if it can carry the proper information, to those who are not members, as to its use. Will those who join between now and the issue of the "proceedings" receive copies of any of the back volumes, Mr. Secretary? We think you might make some offers in this line.

To any person not now a member of the society, nor a subscriber to *The Microscope* who will join the society during the coming three months, we will send *The Microscope* free of charge during 1896.

All articles contributed to our columns by members of the society the coming six months, will be headed by the title of article, the name of the contributor and the words:

MEMBER OF THE AMERICAN MICROSCOPICAL SOCIETY.

Readers will thus be able to see what the members are doing for them, and will, we think, have increased thereby their respect for the society. We beg to suggest to Miss Booth in this connection that she do the same in her excellent little magazine, "Practical Microscopy." She cannot be more practical than this.

Of course, if any contributor wishes us to withhold the above announcement that he is a member of the society, we will make the exception in his case.

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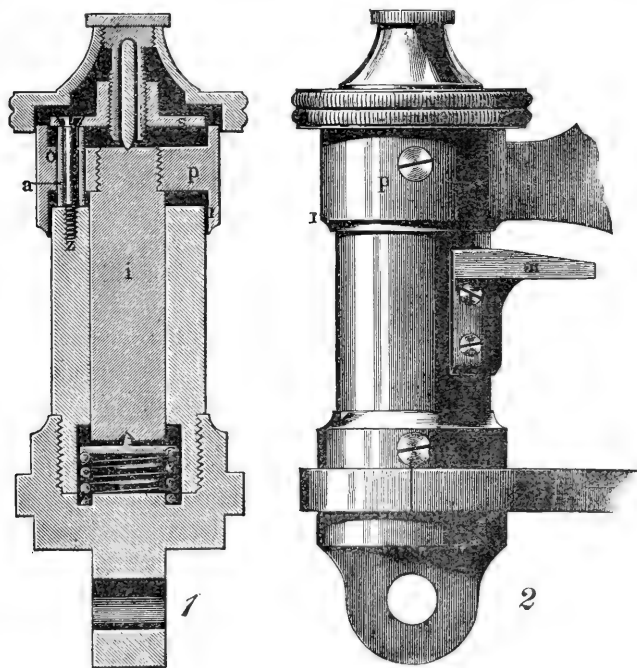
### MICROSCOPICAL APPARATUS.

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**Comments on the Construction of Microscope Stands.**—Speaking on this subject in the *Zeitschrift für Wissenschaftliche Mikroskopie* (vol. XII, 2, 1895), Dr. H. E. Hildebrand of Chicago, recommends a few changes in the construction of the microscope stand, especially that of the Continental type, which tend to raise their standard in regard to durability, stability, and ease in manipulation.

As our colleges are owners of the microscopes which they furnish in great numbers to the different classes of their students,

this circumstance—the large number of the instruments and of those who use them—in a very striking manner discloses the weak points in the construction of the stands, certain parts of which, with great regularity, become defective after some usage. These weak parts include the micrometer screw, which has become unreliable and shaky; the prism which has undergone torsion and flexure in a sufficient degree to produce lateral motion, making focussing problematic; and the fastening of the prism to the stage which has lost its firmness. The author attributes



these shortcomings mostly to the fact that the continental stand, unlike the Jackson pattern, in none of its parts offers to the hand a solid and convenient hold by which it may safely be transferred and manipulated.

As a corrective, a reversed arrangement of the component parts of the fine adjustment is recommended. The prism sleeve is solidly united with the stage and the prism with the tube carrier. When the fingers of the operator now grasp the instru-

ment by the prism sleeve for any change of place or position, they no longer—as under the old construction is the case—subject the prism, its fastening, and the micrometer screw to undue strain, especially as a horizontal plate (*m*) projects from the prism sleeve and expands underneath the arm of the tube carrier, preventing the fingers from coming in contact with any of the parts above.

With the help of the illustrations the details of the new construction will be understood. The block of the joint, the stage and the socket (Fig. 1 and 2), for the reception of the prism sleeve are made of one casting. At the bottom of the socket and within the sleeve a chamber is seen for the spiral spring which forces the prism *i* upward against the micrometer screw. The latter is placed in the center of a disk *s* (Fig. 1 and 3), which is supported on three hollow pillars *a, a, a*, standing on the upper end of the sleeve, and three screws *z* (Fig. 1. and 3), serve to combine disk (Fig. 3), pillars and sleeve into one firm structure, from and through the top of which the micrometer screw can with exactness control the ascending prism *i*. In order to unite the prism with the tube carrier, the arm of the latter flattens out into a thick, round, horizontal plate *p*, the central portion of which receives the prism by means of a screw thread, whilst its circumference projects downward, in the form of a ring *r*, over the prism sleeve. In order to gain passage-ways for the pillars *a, a, a*, the plate *p* is provided with three openings *o, o, o*, of such ample width that any contact of the pillars with plate *p* is made impossible.

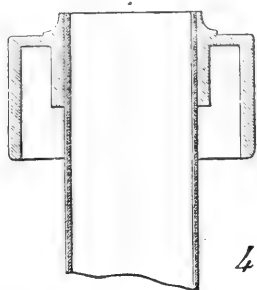
All those parts of the old construction which have given satisfaction have been retained, only such factors having been eliminated as exert a deteriorating influence on the fine adjustment.

For the sake of differentiation we insert plates Fig. 8 and 9, taken from the catalogues of Zeiss of Jena, and Leitz, of Wetzlar, showing the construction of the fine adjustment as used by these firms.

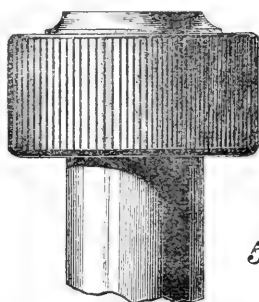
**The Horseshoe-Foot.**—The advantages offered by this foot-form are not fully appreciated and turned to use. The character of this foot must not be confounded with that of a tripod. This latter would have three points to rest upon which, when



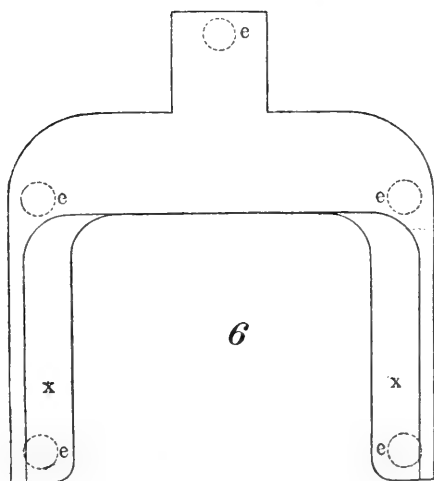
connected by straight lines would form an isosceles triangle, the pillars of the stand occupying the angle opposite the base of the triangle. A vertical line drawn through the gravity center of the stand would be in close proximity to one of the long sides



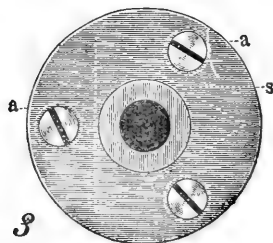
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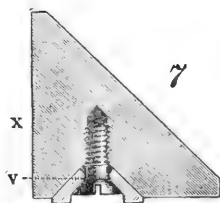
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of the triangle, that is to the border of the area of support, and a small outward force would cause that line to fall beyond this border and consequently upset the instrument. It is here that the horseshoe form may bring relief. It will bring the borders

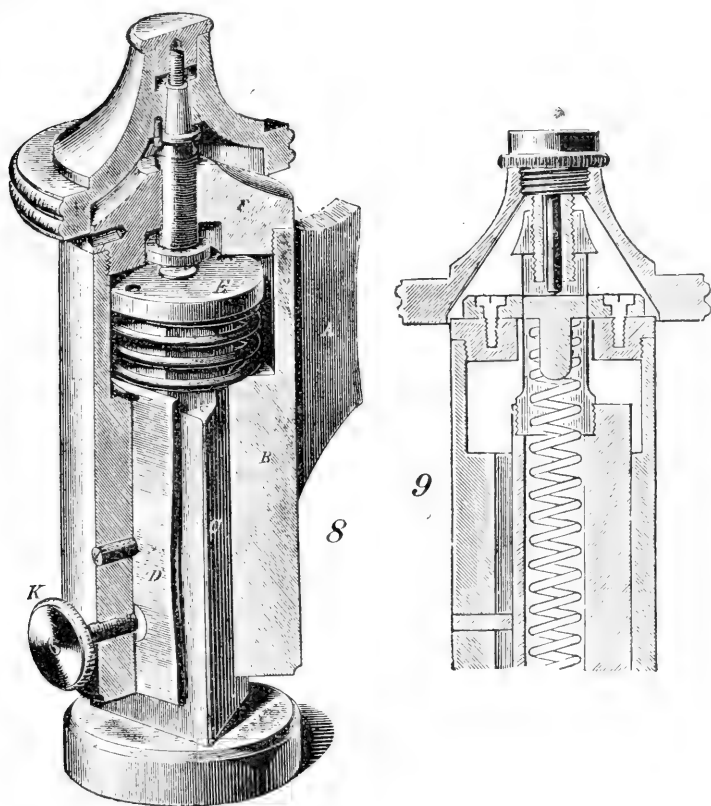
of the supporting area at a greater distance from the line of gravity, and do so especially at points where a widening is most needed, viz., at the right and left hand sides of the pillar of the instrument.

Clear as this principle is, we find the modern horseshoe-foot by no means always built in accordance with it. Its width across the pillar is contracted and often left here altogether without supports, which are placed at the extreme ends of the side bars and at a spot behind the pillar. In this manner, resting upon three points, the horseshoe-foot assumes the faulty qualities of the tripod just mentioned.

The accompanying drawing shows the foot of a microscope made by MERZ of Munich, 35 years ago. This foot has proved of such superior excellence, that its type, in various sizes, has been substituted for the bases of other stands with the same gratifying results. What in other horseshoe-forms presents a narrow curve expands here (Fig. 6 and 7), to an almost straight comparatively long bar *b*, which by short turns extends its branches *xx* parallel to each other, the aperture from branch to branch being equal to the width of the microscope stage. Although the shape of this foot suggests rather the form of a pronged bar, than that of a horseshoe, it is plain from the preceding that here not only are the advantages inherent to the horseshoe base fully utilized, but greatly enhanced. The branches, as seen in the drawings represent three-sided prisms *x x* Fig. 6 and 7, sloping toward the median line of the foot. This particular, in connection with the wide opening of the branches, creates a roomy, well-accessible space beneath the stage, even down to the top of the working table, making considerable depression of the stage permissible. The total width of the foot as compared with its length (back-toe not included) is about 7:6. Five leather disks *e*, embeded in recesses *v* form the sole of this foot.

Further attention is drawn to the relation in size of the base to that of the body and especially the stage. In the endeavor to reduce the dimensions of the continental microscope, a point has been reached where overdoing a good thing is partially in sight—partially an accomplished fact. The first relates to the base of the larger stands, the second to that of the smaller ones.

They refuse to stand up under legitimate manipulation, thus revealing their character as miniature stands, whilst they should have a base of such dimensions—regardless of the size of the superstructure—that microscopical operations may be per-



formed with safety. Here, the Merz foot will supply the remedy.

**Microscope Stands With Coarse Adjustment By Sliding Tube.**—These stands do not seem to receive the same careful attention as the higher grade stands on the part of the manufacturers. This fact becomes manifest when we receive a great number of these small stands from different sources at one time.

With few exceptions only, the working of the tube in its sleeve is much too hard, the makers not having taken into consideration that the preservation of the fine adjustment in a large measure depends on the smoothness of motion in these parts. Often the sleeve is faulty, in some cases being compressed to a slight oval, in others being wider at the lower end than at the upper, where alone the tube is grasped by the slit sleeve, at the lower end allowing an all-around-motion of the tube. Only those instruments give full satisfaction which possess a tube perfectly cylindrical, and a sleeve of perfect adaptation.

With gratifying results the author has equipped the tube with a larger ring for manipulation, indeed resembling more a drum, which may be securely held, even in varied positions of the hand. The ring (Fig. 4 and 5), is two inches in diameter, its rim extends down one inch. It has been shown that beginners are much less liable to crush their coverglasses with the tube and drum than with the plain tube, greater comfort being here combined with superior control. With only ordinary skill a  $\frac{1}{4}$ -inch objective may at once be focussed without difficulty.

#### **Microscope for the Examination of Opaque Objects.—**

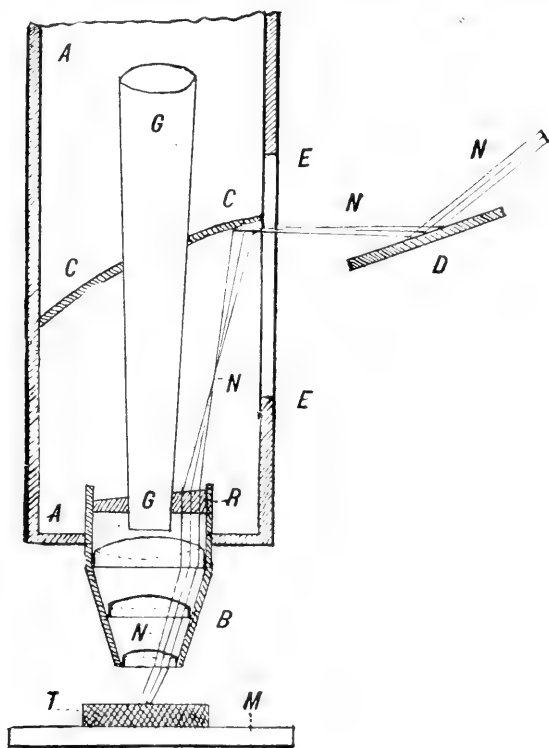
Several attempts have been made up to the present time to devise apparatus for the illumination of opaque objects examined under the microscope. One of the best known processes is that of Lieberkuhn, which consists in applying around the objective an inclined concave mirror, which concentrates the luminous rays in reflecting them upon the preparation. This apparatus cannot be applied unless the frontal distance of the objective is sufficient to permit of the passage of the luminous rays sent obliquely. It can, therefore, be employed only for feeble magnifications. Moreover, such oblique illumination is an inconvenience.

Mr. Charles Fremont has succeeded in effecting the illumination through the interior of the tube of the microscope and the objective, so that this new method is applicable to even the strongest magnifications. The arrangement adopted as described to the Academy of Sciences, through Mr. Marey, is as follows:

The pencil of light is directly projected or reflected by the mirror D, enters the body A, of the microscope tube, through

an aperture, E E, and meets a concave mirror C, which is movable and capable of being raised and lowered in order to send the light through the lenses of the objective B. A prism, R, is interposed in the path of the pencil in order to right it and render it parallel with the axis of the microscope before it enters the objective.

The mirror C, and the prism R, are provided with an aperture, G, that allows one to



perceive, through the ocular, the image of the preparation, T, given by the objective B, so that such image is never met by the luminous pencil.

This process permits of obtaining a vertical illumination of great intensity, and of perfect clearness, both qualities indispensable for photographing microscopic images.

In presenting this apparatus to the academy, in behalf of Mr. Fremont, Mr. Marey recalled the experiments that he had made toward reproducing microscopic beings by chromophotography. With ordinary illumination the objects detach themselves from a luminous ground and successive photographs of them can be taken only upon a movable film. The series of images thus obtained, include, it is true, all the data necessary for determining the changes of form and position of the object in motion; but in order to appreciate such changes, it requires considerable labor in the way of comparing the images, which are intimately connected in a long series. For such studies it would be preferable to have recourse to chromophotography upon a dark ground, which, upon the same immovable plate, reunites the successive images of the object.

This method, which has been applicable only to objects of large dimensions, will, perhaps, owing to Mr. Fremont's new instrument, be applicable to microscopic photography. Should such be the case a great progress will certainly be made in our knowledge of the motions of microscopic beings.—*Scientific American*.

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### MICROSCOPICAL MANIPULATION.

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**A New Borax-Carmine.**—Everyone who has worked at botanical microscopy has fretted at the difficulty of using borax carmine in staining plant sections. It is a splendid stain, but to get satisfactory work with it, it is necessary to practically destroy all cell contents and consequently is useful only in skeleton preparations. Professor Radais, of the Ecole de Pharmacie, Paris, has recently discovered a mode of preparing the reagent which entirely obviates this disagreeable trouble. His process as communicated to the *Journal de Pharmacie*, is as follows: Put in a balloon, arranged with reflux refrigerating apparatus, a mixture of pulverized carmine (No. 40), 2 gm.; borax 8 gm.; alcohol of 70°, 200 gm. and heat on a water-bath. Let the alcohol boil for twenty minutes, then cool slowly and filter. The alcoholic tincture should index exactly 70° alcoholometrically, and where a good condensing apparatus is not at hand use alcohol of 71° or 72°. The reagent keeps well in closely

stoppered vials. In using it it is necessary to let the sections to be stained lie for a few moments in alcohol of 70°, and then transfer them directly into the stain. It acts most energetically upon the nuclei and especially upon the cellular membranes, and is rapid in direct proportion to their richness and pectic compound. It has no action on the ligneous and suberific parts. The best results require about ten minutes contact, but super-coloration is not to be feared with even much longer contact. After removal of the sections from the stain, wash them in alcohol of 70°, dehydrate and mount in any anhydrous medium. By this method all precipitation of coloring matter within the cells is avoided.

**Stain for Blood-Corpuscles.**—Toison, in the *Prager medizinische Wochenschrift*, recommends the following solution for staining blood-corpuscles:

Sodium sulphate.....	8 gm.
Sodium chloride.....	1 gm.
Methyl violet.....	25 mgm.
Glycerin.....	30 ccm.
Distilled water .....	160 ccm.

Mix the glycerin and water, dissolve in the mixture the sodium salts, and finally the methyl violet, and filter. The red cells preserve their shape excellently, and the white cells (which are also stained) are sharply defined, making differentiation very easy. According to Marschner, who has used the stain extensively, it is most excellently adapted for use in counting the red corpuscles, but he does not recommend it for counting the white cells.

**Staining Agent for the Milk Vessels.**—O Chimani (*Archiv der Pharmacie*) states that in alkaninacetic acid he has found an effective agent for staining the contents of the milk vessels of plants. The following is his method of procedure: Ordinary alkanet extract is purified of the brown coloring matter with which it is contaminated, by means of ether which takes up the alkanin. After evaporation of the liquid, the residual mass is exhausted by acetic acid (45 per cent glacial). This liquid is concentrated somewhat further by evaporation in the water-bath, and is ready for use. It acts not only upon

dry material, but upon fresh vegetation (after hardening in alcohol) and furnishes an excellent agent for differentiating the tannin sheaths and the contents of the sieve-tubes.—*National Druggist*.

**Formalose.**—This drug is guaranteed 40 per cent. solution of chemically pure formaldehyd in water. It is a perfect antiseptic Germicide Disinfectant, Deodorizer and Preservative.

Formalose is possessed of an extraordinary power of microbicide, similar to that of corrosive sublimate, though exhibiting none of its toxicity. It has the peculiar property of attacking only the contagious material.

As a preserving and hardening agent for bacteriological, histological and biological purposes it is of greatest value. Animal objects and sections are hardened without brittleness, shrinkage, loss of color, or of microscopical structure, nor do their staining properties suffer. The eyes remain large and clearer than in alcohol, and the mucus of slime producing animals is not coagulated and remains transparent. Plant structures and most fruits keep well, and microscopical sections of plants that have been in formalose for a long time give fine preparations.

Formalose has the peculiar property of rendering solid, gelatin that has become fluidified by bacterial products. Gelatin, or even gelatin fluidified by bacteria, under the action of Formalose becomes hardened to such an extent that it is rendered incapable of liquefaction by heat. Bacterial cultures of the most active character are completely arrested by the action of Formalose, or the Formalose vapor.

For the preservation of specimens, Formalose is the ideal medium; used in highly diluted form it is superior to alcohol at a considerably smaller cost. As an antiseptic it is used in the proportion of from 2 per cent. to one mille, and being non-toxic, inodorous and without ill effects on clothes, or on textile fabrics, it is a perfect deodorizer and disinfectant for the hospital and sick room.

It is sold by Richards and Co., limited, New York, and Chicago.



### MICROSCOPICAL SOCIETIES.

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#### San Francisco, Cal.—W. E. Loy, Secretary.

*September 4, 1895.*—Prof. W. E. Ritter gave an account of his year's leave of absence granted him by the Regents of the University of California, and which he had spent in Europe, particularly at the Biological Laboratory at Naples. He had also spent much time with the Marine Biological Association of Liverpool.

Dr. Eisen exhibited a slide of blood corpuscles of the black Salamander, stained by the Haidenhaim method. The preparation had been mounted in a new medium prepared by Charles C. Reidy,—bisulphide of carbon and gum thus. This medium is of very high refractive index, and gave a brilliancy of color and perfection of outline not produced by any other medium the doctor had used.

*October 2.*—The principal feature of the meeting was a paper by Melville Attwood, a mining expert on some simple modes by which the external characters alone are used for distinguishing mineral substances. The reading of the paper was illustrated by an exhibit of much interest.

*October 16.*—A conversational meeting was held at the rooms 432 Montgomery street, John C. Spencer, M.D., president, in the chair. M. J. Rosenau, M. D., of the United States marine hospital service, Washington, D. C., read a paper on Immunity and Immunization.

#### Washington, D. C.

*October 8, 1895.*—The first meeting of the season after the summer vacation was devoted to the election of officers and the discussion of plans for the winter's work.

#### Leavenworth Academy of Science.

*October 26, 1895.*—There has been re-organized in Leavenworth, Kansas, the "Leavenworth Academy of Science" an organization that was chartered under the laws of the State of Kansas, on October 3, 1873, but that had lapsed some ten years ago.

The different departments of science are assigned to sections

with a leader and progress in each department of learning is to be reported by the head of each section every three months.

The officers of the Academy shall consist of a President, Vice President, Secretary, Treasurer, Librarian and a Board of Trustees, the Board of Trustees to consist of those mentioned above and two additional elected annually same as those above.

There being quite a number of fine microscopes and accessories in the city, the section on microscopy will include all the members of the old Leavenworth Microscopical Society and this latter society which has met in the last several years will cease to exist, either in name or act.

A permanent library and museum quarters have been tendered by the City Board of Education as well as a plan of meeting both special and public for the sections and the Academy as a whole, special meetings to be held in the Board of Education rooms and the Academy's public meeting are to be held in the Leavenworth High School Auditorium.

Meetings of the Academy are to be held on the first and third Thursdays in each month, public meetings every ninety days.

The last meeting, which was the first regular meeting was held on October 24, at which Dr. James A. Lane read a paper on the biological examination of the city's water supply, illustrating the same with cultures of micro-organisms found therein, discussions of this paper was laid over until November 7th.

There are two reasons why I have written thus fully of our organization. First to let the Journal know that the Leavenworth Academy of Science has organized and expects to do some good work and second to let them know that the Leavenworth County Microscopical Club or society has been dead for several years and that those interested in what was the old society are now in the microscopical section of our new organization.—J. W. MCGILL, M. D., Secretary.

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## LETTERS TO THE EDITOR.

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BUFFALO, N. Y., Nov. 11, 1895.

CHAS. W. SMILEY, EDITOR.

MY DEAR SIR:—In reply to your excellent editorial challenge, will say that you certainly have the correct remedy to tone up and restore to health any and every society suffering with debility, paresis or melancholia. The success of any society depends upon the activity of its secretary and execu

tive committee *after* the meeting, of its President *before* the meeting, of its members at the meeting and of its treasurer and journals *the whole year long*. A society medical or scientific needs not so much of pull as of push and that coming not from a handful of loyal and faithful ones, but from every member of the organization be he in the van or in the rear. Only too often is the rule that a ring or clique controls the actions of a society and dampens the ardor and enthusiasm of its members. This I believe does not hold true with regard to the A. M. S. To be sure we have leaders and they are as necessary as the followers but the weight of responsibility should and does rest equally heavy on both. The A. M. S., had one of its most successful meetings at Ithaca last summer in its history, thanks to Professor Gage and his associates and all indications point to an even more successful meeting in 1896.

The Secretary relies upon your valued journals to do their share of preparatory work and also the help of Mr. Reunsk and Miss Booth and other editor-microscopists. The transactions of 1895, will be out in time for your Journals to review in the January numbers. Before then you need not expect to receive any paper read at that meeting for publication because I have corralled them all but one and intend to have them appear first in the transactions of a society, afterwards wherever the reader desires and so spread the name and fame of the A. M. S.

Your activity in enlisting new members is very commendable and cannot help but bear good fruit. Professional workers as well as amateurs are to be exhorted to become members and once members to become active and look forward to each meeting as a vacation combining "knowledge with pleasure." The editors of our microscopical journals will be supplied with blanks for admission, and by an amendment to the constitution to be acted upon at the next meeting and it doubtless will be adopted, election to the society will be easier and quicker than heretofore. To be a member of the A. M. S., should be as proud a claim as to be a fellow of the R. M. S.

Yours sincerely,

WM. C. KRAUSS.

---

SYRACUSE, N. Y., Nov. 12, 1895.

TO THE EDITOR OF

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

DEAR SIR :—The active and generous interest The Microscopical Journal takes in the American Microscopical Society is thankfully appreciated. The Ithaca meeting was a success in every way and emphasized the fact that the society is far from being in a dying condition. With the sense of well-being disseminated by the Ithaca meeting, the promises made by *The Microscopical Journal*, the similar interest *Practical Microscopy* has in the welfare of the society, and invitations already in hand to meet next year as the guest of well-known and enthusiastic local microscopical societies, the executive committee can work with a determination to add materially to the strength of the national organization. Interest in microscopical research is the key

to membership. Therefore, every reader of *The Microscopical Journal* can unlock the door. Come in. A cordial welcome will be yours, be your work ever so humble.

A. CLIFFORD MERCER,  
President of the American Microscopical Society.

---

CHICAGO, ILL., Nov. 15, 1895.

808 MORSE AVE., STATION Y, CHICAGO.

DEAR MR. SMILEY :—Your editorial is all right, but for people who have 36 hours work in 24 and no pay for it, it is a question how best to help in this matter. First, people disagree, all are so separated that we cannot get together to make up any work. Then physicians or teachers are a hard class to be sure of, one may or may not get away and the other wants a vacation. I am very strongly in favor of practical working sessions. Several members of the Society at the last meeting all stated they had thought they would see how things were done and get practical information. The local societies are in much the same condition and if I may believe what I hear, Buffalo, Pittsburg, San Francisco and Washington head the list in any work. This Society here is weak and the Chicago Academy has not helped it by a great deal. There is an apathy existing and it makes it difficult for a beginner or younger member to stir up the older members. I do not approve of the Journals over here at all. \*The Microscope, as edited by Manton, was one of the most valuable periodicals going, but now there is not a decent one existing. The Royal is also going down. I suppose the reason being as I was told the other day—"There is no such thing as Microscopy because it is used in all the Sciences &c., &c. I object most strongly to going into Journal of Morphology, Journals Anatomy and Physiology, Photography, Medicine, Hygiene etc., for micro. work. Micro. work ought to be all collected under departments and give resume of paper but full extraction of the methods in Botany, Fungi, Bacteria, Photography, Histology, &c. I would rather pay more and have a good Journal and save time, annoyance and expense.

Yours very truly,

V. A. LATHAM.

\*It will be borne in mind by our readers, that the writer of this letter is one of the editors of an English microscopical periodical and that she, an American, sends most of her contributions abroad to be published.—EDITOR.

---

WANTED.—A Watson & Sons "Students Stand D," or a "Van Heurk," must be in a good condition. Address, W. C. POLLNER, Cleveland, Ohio.

WANTED.—Microscope, with one or two objectives, for good general work, by any recognized standard maker. Must be cheap and in perfect condition. Address, with full particulars, LIBRARIAN, STEEL WORKS CLUB, Joliet, Ill.

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